VOL. 5 No. 6 June, 1961

COMPUTER ABSTRACTS

Editor: B. A. Fancourt, B.Sc.

Published by Technical Information Company, Ltd., Chancery House, Chancery Lane, London, W.C.2.

CONTENTS

GENERAL 1
DESIGN 2
LEARNING AND PATTERN RECOGNITION .. 3
MATHEMATICS 4
TECHNIQUES 5
ACCESSORIES 7
ELEMENTS 8
ANALOGUE 10
DIGITAL 11
PROGRAMMING 11
APPLICATIONS
Aeronautical 13
Business 14
Chemical 14
Control—General Systems 14
Control—Production and Process 14
Electronics 14
Engineering, Electrical 14
Engineering, Mechanical 14
Information Retrieval 14
Mechanical Translation 15
Medical 15
Military 17
Nuclear 17
Physics 17
Simulation 18
Transport 18
Miscellaneous 18
BOOKS 19
AUTHOR INDEX 19
PATENT INDEX 20

GENERAL

1076 **Around the world in computing.** G. P. Anderson and E. J. Guerin, *Datamation*, **7,** April 1961, 56-59. Consists of the following short articles:

a. **West Germany's TR-4.** p. 56-57. Brief details of the Telefunken TR-4 parallel, binary computer.

b. **Czechoslovakia's EPOS.** p. 57. Brief account of plans for production of the EPOS computer in Czechoslovakia.

c. **Great Britain's Elliott Ltd.** p. 57-58. Brief descriptions of Elliott products—paper tape reader, magnetic drum stores, magnetic disc stores, magnetic film stores, and Compuprinter.

d. **China—USSR language translation.** p. 58-59. Brief account of work at the U.S.S.R. Academy of Sciences on mechanical translation of Chinese mathematical texts into Russian.

1077 **Computer census.** *Data Processing (Detroit)*, **3,** April 1961, 32-33. The numbers of more than fifty digital computers on order and delivered (in the U.S.A.) are listed with comments regarding the accuracy of the figures.

1078 **Computing in engineering education.** *Datamation*, **7,** April 1961, 29-30. Account of the policy to be adopted by Purdue University's School of Electrical Engineering in teaching digital computers with the aid of an LGP-30.

1079 **Data processing—What next?** J. M. Salzer, *Proc. Western Joint Computer Conference*, 1960, 193-202. This paper discusses trends in circuits and components; data systems and equipment; programming and common languages; human factors and overall system design; and learning and cerebral systems. The future of data processing is considered generally from the viewpoint of making 'data processing machines more truly the direct extension of the human intellectual process.'

1080 **European information technology.** I. L. Auerbach, *Bull. Provisional Int. Computation Centre*, No. 13, April 1961, 11-51 and three charts following page 51. This report on the industry and the state of the art was published in a condensed form as 'European electronic data processing—a report on the industry and the state-of-the-art' in *Proc. IRE*, **49,** Jan. 1961, 330-348 (*C.A.*, **5,** April 1961, Ref. 623). In its present form, the section of the report dealing with technological developments and the tabulated characteristics of digital computers are substantially the same as in the earlier publication. However, considerably more information is given as to the activities of European manufacturers and centres.

1081 **Iterative circuit computers.** J. H. Holland, *Proc. Western Joint Computer Conference*, 1960, 259-265. (N.B.—The title of this paper is given in the contents list and elsewhere as 'On iterative circuit computers constructed of microelectronic components and systems'). Computers constructed of hundreds of millions of logic and storage elements will require an organisation radically different from present computers if the elements are to be used efficiently in computation. It should be possible to process arbitrarily many words of stored data at the same time, each by a different sub-program if required. In addition the structure of the computer should be iterative or modular in order to allow efficient use of template techniques in its construction. This paper is concerned with computers satisfying these conditions. After outlining one possible abstract prototype for such a computer, a mathematical characterisation of a broad class of computers satisfying the conditions is summarised and its interpretation considered. Finally, the characterisation is related to a project aimed at establishing a theory of adaptive systems via the concept of automaton generators. 14 refs. See also Refs. 1082 and 1083.

1082 **On programming a highly parallel machine to be an intelligent technician.** A. Newell, *Proc. Western Joint Computer Conference*, 1960, 267-282. This paper speculates on how to program a machine that is suitable for microelectronic components to be an intelligent technician. The point of departure is from the class of machines described in Ref. 1081. An intelligent technician is considered here as a machine that is approximately equivalent to an extremely compliant, fairly bright, human technical assistant backed by an impressive computing establishment. The basic organisation for information processing is considered and, more briefly, the organisation for problem solving, supervision, interpretation and production. 9 refs. See also Ref. 1083.

1083 **On a potential customer for an intelligent technician.** C. W. Churchman, *Proc. Western Joint Computer Conference*, 1960, 283-284. This paper discusses a possible field of application for the iterative circuit computer or intelligent technician of Refs. 1081 and 1082. The field is that of the bargaining problem such as arises in purchasing, voting, labour-management disputes, legislation, treaties and the cold war.

1084 **On microelectronic components, interconnections, and system fabrication.** K. R. Shoulders, *Proc. Western Joint Computer Conference*, 1960, 251-258. Microelectronic data processing systems are analysed and various requirements for components are considered. It is pointed out that the reduction in trans-

Digitized by the Internet Archive
in 2024

https://archive.org/details/computer-abstracts_1961-06_5_6

mission line cross-section causes increased losses in microelectronic systems thus giving rise to the need for high impedance components for non-cryogenic applications. Proposals are discussed for a new component, called the tunnel effect vacuum tube, that seems particularly suited for microelectronic system requirements and fabrication methods. This component is based upon the quantum mechanical tunneling of electrons into vacuum; has an estimated switching time of 10^{-10} seconds; promises immunity to temperature variations; and seems adaptable to self-forming manufacturing methods giving component uniformity. It is intended to employ vacuum tunnel effect devices in a system that uses only optical input converters, electroluminescent generators, and a means for interconnecting components. Possible interconnecting means are discussed. Finally, methods of constructing microelectronic devices are considered. A method of electron beam activated micromachining for film materials is presented in which a thin chemically resistant film is formed with an electron beam to selectively protect the film being machined during a subsequent molecular beam etching. This high speed process has resolution capabilities of several hundred angstrom units and may ultimately be suited for the economical production of one cubic inch data processing systems having 10^{11} active components. 20 refs.

1085 **The role of the digital computer in the university.** A. J. Perlis, *Computers & Automn.*, **10,** April 1961, 10-12, 14-15. The purposes of digital computers at universities are discussed with particular reference to education in the use and programming of computers. 3 refs.

1086 **Step by step.** W. H. O'Keeffe, *Data Processing (Detroit),* **3,** April 1961, 20-24. An account of the steps of planning for and installing an IBM 305 RAMAC for inventory and production control at the Elmes and King Division of Americal Steel Foundries.

1087 **Information processing.** Lincoln Lab., M.I.T., *PB 153361,* 15 Sept. 1960, 58 p. Contents: Digital computers; Data processing; Computer components; Pattern recognition; Analysis; Psychology. 11 refs.

1088 **A survey of operations and systems research literature.** M. W. Raben, Tufts University, Medford, Massachusetts, *PB 152914,* 1 Jan. 1960. 125 p. 1,021 refs.

DESIGN

1089 **Analysis of a basic queuing problem arising in computer systems.** P. E. Boudreau and M. Kac, *IBM J. Res. & Dev.*, **5,** April 1961, 132-140. In this paper, a model which describes a basic junction or queuing structure arising in a general computing system is subjected to a mathematical analysis. The results consist of several formulae describing the performance of various parts of the system and which can be used to answer such questions as: What should be the relationship of input/output speeds to central processing speeds? What is the size and type of buffer needed to handle queues that may develop in the system? What action should be taken with regard to these queues? Results of Monte Carlo routines run on an IBM 704 to simulate the model are compared with those predicted by the theory.

1090 **ATHENA: design for reliability.** *Auto. Control,* **14,** April 1961, 62-65. A general account of the designing of ATHENA, the digital guidance computer for the intercontinental ballistics missile Titan, by Remington Rand Univac Division of Sperry Rand Corporation using simulation on a UNIVAC Scientific and other means to obtain the very high reliability required.

1091 **A built-in table lookup arithmetic unit.** R. C. Jackson, W. H. Rhodes, W. D. Winger and J. G. Brenza, *Proc. Western Joint Computer Conference,* 1960, 239-250. This paper describes an arithmetic unit, a refinement of which is used in the production version of the IBM 1620, requiring fewer stages of logic and fewer components than conventional adder circuitry. The decimal digits in an arithmetic field are used to complete memory addresses which in turn are used to reference a set of answers prestored in magnetic core storage. Multiple non-contiguous memory addresses stored in the machine hardware then reference the various digital positions of the sum, difference or partial product at the proper time in the arithmetic cycle to develop the result. The accuracy of all results is verified by performing an automatic validity check on the data paths within the computer system.

1092 **Encoding of incompletely specified Boolean matrices.** T. A. Dolotta and E. J. McCluskey, *Proc. Western Joint Computer Conference,* 1960, 231-238. The problem discussed in this paper is a generalisation of the problem of choosing the binary codes for the various operations of a digital computer with a view to minimising the gating circuitry in the computer's central control. The general procedure is a systematic method for the simultaneous encoding of a large number of arbitrary Boolean functions in an economical manner. The method is applicable to those cases where the designer is allowed to choose the independent variables so as to minimise the circuit which realises the given Boolean functions. The method includes a means for determining the lower bound on the cost of the circuit which realises the given Boolean functions. The entire procedure is systematic and lends itself well to mechanisation via a digital computer program. Advantages and limitations of the method are discussed. 8 refs.

1093 **Frequency logic.** N. C. Ford, *IBM Technical Disclosure Bull.*, **3,** April 1961, 23-24. Description of the performance of logical operations in a system in which decimal digits ranging from 0 to 9 are represented by frequencies ranging from 10.0 to 10.9 Mc/s.

1094 **High-order-first arithmetic device.** F. K. Allen, *IBM Technical Disclosure Bull.*, **3,** April 1961, 21-22. Describes the operation of circuitry for performing qui-binary addition or subtraction by handling the high order digits first. The system utilises a special 6-bit code which contains four numeric bits and two zone bits. The numeric bits 8, 4 and $\pm$ 2 provide the quinary values of 0, 2, 4, 6, and 8; the numeric bit 1 provides the binary values 0 and 1. The zone bits are used either to encode alphabetic data or when performing addition to store the carries from the qui-binary adder.

1095 **Horizons in computer system design.** W. F. Bauer, *Proc. Western Joint Computer Conference,* 1960, 41-52. This paper propounds the thesis that insufficient time and energy has been devoted to the analysis of computer organisation or system design, developments in organisation having been overshadowed by developments in circuitry and components. After briefly reviewing the status of computer organisation, requirements for three broad areas of computer application—computing, control and information—are considered, and special attention is directed to the information system with the great need for a computer which can adapt to problems. Trends in computer organisation such as concurrent operation, modularity, control hierarchy and integral interrogation and display are discussed. Finally, the application of queuing theory to information system analysis and the development of design methodologies are considered. 3 refs.

1096 **A magnetic associative memory.** J. R. Kiseda, H. E. Petersen, W. C. Seelbach and M. Teig, *IBM J. Res. & Dev.*, **5,** April 1961, 106-121. This paper is concerned with the associative memory, i.e. a storage system in which data flows in and out on the basis of content rather than location (address). The paper presents a novel approach to the design of practical associative memories by examining the logical requirements of a basic associative memory register, by describing the implementation of this basic register with presently available magnetic devices that are economically feasible and by indicating some critical design parameters. A small experimental model of a basic associative memory using ferrite toroids is described to demonstrate the technical feasibility of operation of the individual components in an integrated system. In order to indicate the potential utility of associative memories, a proposed large, fully associative memory system is described, along with a brief discussion of its capabilities from the programmer's point of view. 16 refs.

1097 **Organization of computer systems—the Fixed Plus Variable Structure Computer.** G. Estrin, *Proc. Western Joint Computer Conference,* 1960, 33-40. This paper discusses work at the University of California, Los Angeles on the problems of designing a variable structure computer system. The primary goal of the Fixed Plus Variable Structure Computer is stated as 'to permit computations which are beyond the capabilities of present systems by providing an inventory of high speed substructures and rules for interconnecting them such that the entire system may be temporarily distorted into a problem oriented special purpose computer'. 17 refs.

1098 **Shift-register logic.** R. W. Brooks, *Instr. & Control Systems,* **34,** April 1961, 656-657. Logic circuit for a shift register stage is developed by means of symbolic logic and logic charts.

1099 **Simplified parity check circuitry.** F. C. Dellacato, *IBM Technical Disclosure Bull.*, **3,** April 1961, 25-26. Describes a system for determining the parity of bit combinations stored in a group of devices such as flip-flops. Appropriate outputs of the flip-flops are fed to the inputs of a multi-level decoder which controls a standard, four-gate parity matrix used for generating output, parity indicating pulses.

1100 **Tree.** J. Earle, *IBM Technical Disclosure Bull.*, **3,** April 1961, 38-40. Discusses a complete logic tree which is a decoder and starting point for minimisation of decoder type circuits. A two-input-variable tree, for example, provides four outputs which are terms of the standard sum of products. However, should the logical requirements be less than a complete decoder, certain unnecessary branches of the tree may be removed without loss of the required logic.

1101 **Research on general digital logic systems utilizing magnetic elements and wire only.** E. K. Van De Riet and C. H. Heckler, Stanford Research Institute, *PB 153206,* Oct. 1960, 78 p. A machine was designed to prove the feasibility of all-magnetic logic systems. All of the circuits except input, output and pulse power supply were built exclusively of ferrite magnetic elements and copper conductors. The machine described is an arithmetic element which performs addition, subtraction and multiplication with three-digit decimal numbers. It carried out all operations correctly with a simultaneous variation of $\pm$ 10% on all drive pulse amplitudes. Input is through a keyboard and output is in the form of indicator lights. A laboratory pulser was used to supply the clock pulses. 11 refs.

1102 **Timing circuit.** Associated Electrical Industries Ltd., *B.P. 865921,* 26 April 1961. This patent is concerned with a serial timing circuit for digital computing apparatus, comprising a chain of bistable transistor stages to which a common shift signal is supplied so that the stages are sequentially operated.

1103 **Arithmetic unit.** Philco Corp., *U.S.P. 2964242,* 13 Dec. 1960. This patent describes an arithmetic unit for a parallel, asynchronous, binary computer and which has special features for the extraction of square roots.

1104 **Setting function generators.** Reeves Instrument Corp., *U.S.P. 2964709,* 13 Dec. 1960. Apparatus is described for the speedy adjustment of function generators to obtain desired transfer characteristics.

1105 **Magnetic core matrix addressing circuit.** Int. Business Machines Corp., *U.S.P. 2964737,* 13 Dec. 1960. An addressing circuit for supplying readout pulses to a magnetic core matrix, employs pulse transformers.

1106 **Floating point arithmetic.** Burroughs Corp., *U.S.P. 2965297,* 20 Dec. 1960. A circuit is described for use in floating point multiplication or division to indicate when stored operands are indicative of a product or quotient equal to zero.

See also :—
General, Ref. 1081 and 1084.

LEARNING AND PATTERN RECOGNITION

1107 **Computer simulation of human thinking and problem solving.** H. A. Simon and A. Newell, *Computers & Automn.,* **10,** April 1961, 18-19, 22-24, 26. This paper is concerned with the General Problem Solver program. After discussing the structure of the program and the generality of ends-means analysis, the acquisition of speech by a child is considered and, finally, the simulation of this process by the General Problem Solver program is described. 12 refs.

1108 **Developments in cybernetics.** F. H. George, *Automn. Progress,* **6,** April 1961, 127-130. Some current and future applications of cybernetic theory to practical problems of society, business and industry are examined; mention is made of the part to be played by digital and analogue computers. 2 refs.

1109 **Empirical explorations of the geometry theorem machine.** H. Gelernter, J. R. Hansen and D. W. Loveland, *Proc. Western Joint Computer Conference,* 1960, 143-149. Summary of a full paper to be published elsewhere, and discussing results obtained with a geometry theorem proving machine which is a particular state configuration of the IBM 704 specified by a program. 10 refs.

1110 **Farrington has optical scanning lead.** V. Wentworth, *Datamation,* **7,** March 1961, 23-25. This article lists American firms who have ordered Farrington optical scanners, briefly explains how optical scanning works and describes the Farrington Selfchek type fount. A brief account is given of the latest Farrington scanner which can read letters, numerals, punctuation marks and symbols.

1111 **IBM's optical reader provides direct entry.** *Datamation,* **7,** March 1961, 27. Brief account of the IBM 1418 optical character reader used for input into the IBM 1401.

1112 **A line-drawing pattern recognizer.** L. D. Harmon, *Proc. Western Joint Computer Conference,* 1960, 351-364. A machine is described which recognises line-drawings of circles, triangles, squares, pentagons and hexagons. This identification is independent of rotation and, within limits, of size, precision of drawing or positioning. The system will also distinguish and count separate objects up to six with limited independence of the size, shape and position of each object. This Gestalt recognition is accomplished by using a dilating circular scan. Thirty-two small photocells arrayed in a circle are mechanically puckered across the input plane. Light signals derived from opaque line-drawings are converted into binary representation in a special thyratron register. Time sequencing of logical operations and output displays is relay controlled. The actual decision logic uses a novel combination of optical and electronic devices. It is also shown that this circular scan technique is applicable to automatic detection of letters and numbers over a wide variety of styles. 10 refs.

1113 **Optical character reading at NCR.** *Datamation,* **7,** March 1961, 28. Some remarks on the approach to optical character reading adopted by the National Cash Register Company.

1114 **Optical reading.** *Data Processing (London),* **3,** April-June 1961, 68-77. The Farrington 9SP3 optical reader, the Selfchek type fount which it reads and its application to credit card sales accounting are described at some length. Brief accounts are given of other Farrington readers.

1115 **Optical recognition—the breakthrough is here.** *Datamation,* **7,** March 1961, 22-23. Account of progress towards an American Standard for optical character recognition covering numeric fount and printing specifications, made by the American Standards Association Subcommittee on Character Recognition Standards (X3-1).

1116 **Optical scanning of customer accounts.** G. W. Vogler, *Datamation,* **7,** March 1961, 26. Brief account of how the Atlantic City Electric Company make use of a Farrington Optical Scanner 9DP1 for reading bill stubs in connection with the processing of electricity consumption accounts on an RCA 501.

1117 **Recognition of sloppy, hand-printed characters.** W. Doyle, *Proc. Western Joint Computer Conference,* 1960, 133-142. This paper describes a pattern recognition scheme particularly intended to handle noisy and highly distorted data. A character or other pattern to be recognised is subjected to a set of tests (e.g., maximum number of intersections with a horizontal straight line), and a decision is made only when all the tests have been completed. This decision is based on experience obtained from prior processing of labelled samples. Results are described of some trials made on the IBM 709 of the scheme applied to handprinted capitals. 5 refs.

1118 **A suggested model for information representation in a computer that perceives, learns, and reasons.** P. H. Greene, *Proc. Western Joint Computer Conference,* 1960, 151-164. This paper investigates how computers might represent enough of the structure of the percepts and concepts they handle so that they may sensibly be said to deal with the meaning of these things, rather than just to sort and recombine mere labels for the operator's percepts and concepts. One of the main requirements is that each element of information contain partial representations of many other elements and schemata for their interconnection. Some of these requirements may be met if it proves feasible to represent information in the form of vectors (such as modes of oscillation of a complicated network or resonator) which may be resolved into components in various coordinate systems. These systems represent various points of view from which the information may be regarded, and some of the information in each system is elicited by a probabilistic mechanism for use by a conventional computer. 12 refs.

1119 **Reorganization by adaptive automaton.** M. L. Babcock, University of Illinois, *PB 152876,* 15 Jan. 1960, 148 p. Using the presented limited knowledge of nervous tissue of living organisms as a guide, an attempt is made to construct an adaptive automaton whose internal structure has a similarity to living nervous tissue. The philosophy and operation of a general biological computer is described, the internal components of this computer having functional operation very similar to that of a biological neuron—a basic component in nervous tissue. After describing this general automaton, complete functional specifications of the individual elementary components are ideally established. Using these specifications of so-called artificial neurons, an attempt to reduce the automaton to practice by the use of electronic techniques is made. In this reduction the elementary components are considered as highly versatile information processors, the result being an electronic model of an information system having some of the structural and functional characteristics of nervous tissue. Several of these electronic elementary components were constructed. Experimental tests on these components essentially corroborate the similarity desired between them and the biological neurons. 40 refs.

1120 **Voice Data Processing System.** L. P. Schoene, Melpar Inc., *PB 153455,* 15 Sept. 1960, 67 p. The results of two feasibility studies in connection with modifying the design of the Voice Data Processing System to provide additional processing functions are presented. One of these studies is concerned with the provision of the capability for comparing spectrum pattern descriptions to detect approximate matches between input and stored descriptions. The other study concerns the provision of a capability for coding patterns in clusters. 1 ref.

1121 **Character recognition.** Int. Business Machines Corp., *U.S.P. 2963683,* 6 Dec. 1960. A comprehensive description is given of a character recognition system employing optical scanning and recognition logic which detects the existence of one or more included white areas in the character scanned, the number of separate character portions encountered and the relative times when the white areas and the character portions are encountered.

1122 **Character recognition.** G. P. West, *U.S.P. 2964734,* 13 Dec. 1960. A system for identifying handwritten or printed characters is described, in which characters are transcribed onto a pre-ruled data sheet with certain guide line sets using a substance designed to vary an electrical characteristic, and sensing is effected by an electrode head.

See also :—
General, Ref. 1087.

MATHEMATICS

1123 **Alternating direction and semi-explicit difference methods for parabolic partial differential equations.** M. Lees, AEC Computing & Appld. Maths. Center, New York University, *AEC Res. & Dev. Report NYO-9494,* 1 March 1961, 34 p. The author has previously developed a difference analogue of the energy method for determining the stability of difference approximations to partial differential equations with variable coefficients. In this paper the method is applied to establish the unconditional stability of two types of difference approximations to parabolic differential equations: the implicit alternating direction methods of Douglas, Peaceman and Rachford; and a new semi-explicit method, so-called because it is an explicit method only for certain orderings of the net points. The results apply to parabolic equations with variable coefficients, defined in cylindrical domains with an essentially arbitrary bounded base. 15 refs.

1124 **The analog computer as a teaching aid in differential equations.** L. D. Kovach and W. Comley, *Ann. Assn. Int. Calcul Analogique,* **3,** April 1961, 60-63. This paper describes a lecture-demonstration given at Pepperdine College, Los Angeles, involving the derivation of differential equations for a physical system of masses and springs, their analytical solution and analogue computer solution. This serves to give students understanding of the relation between a physical system and the equations describing it, of systems of differential equations and of analogue computers and computing techniques. 3 refs.

1125 **A case of numerical divergence.** H. Riesel, *BIT,* **1,** No. 2, 1961, 130-131. By definition the infinite series $\sum_{n=1}^{\infty} a_n$ converges to the sum s, if and only if, $\left| s - \sum_{n=1}^{N} a_n \right|$ can be made less than each arbitrary $\xi > 0$, by making N sufficiently large. Thus, by adding together a sufficiently large number of terms at the beginning of a convergent infinite series, a value arbitrarily close to the sum of the series can be obtained. This paper demonstrates, by means of an example, that this is not always true with respect to numerical calculations, i.e. when, instead of adding together the terms of the series, the correctly rounded values of the terms are added.

1126 **Chebyshev approximations to the gamma function.** H. Werner and R. Collinge, *Maths. of Computation,* **15,** April 1961, 195-197. Several Chebyshev approximations are given for the function $y = \Gamma(x+2)$ for x in the $0 \leqq x \leqq 1.0$ range. 5 refs.

1127 **Conditionally stable difference approximations for the wave-operator.** J. Friberg, *BIT,* **1,** No. 2, 1961, 69-86. In this paper, a mixed problem with simple boundary conditions is considered for the two-dimensional wave-operator and for the corresponding system of first order equations. Some particular difference approximations to the problem are studied, and their stability and convergence are proved by means of energy inequalities, when the mesh ratio satisfies certain necessary and sufficient conditions. The case of variable coefficients and additional lower order terms is also covered. 8 refs.

1128 **The determination of the optimum accelerating factor for successive over-relaxation.** B. A. Carré, *Computer J.,* **4,** April 1961, 73-78. In using the method of successive over-relaxation, two difficulties generally arise. Firstly, the efficiency of the method depends greatly on the accelerating factor used, and for any given problem the optimum value of this factor is not usually known prior to solution of the problem. Secondly, it is difficult to estimate the accuracy of solution at any stage. This paper describes a method of using successive over-relaxation in which successively better estimates of the optimum accelerating factor are obtained during the course of solution. The method also yields satisfactory bounds to the error at any stage. Some details of, and numerical results obtained with, a DEUCE program incorporating the method are given. 8 refs.

1129 **The effect of parameters on the roots of an equation system.** C. E. Maley, *Computer J.,* **4,** April 1961, 62-63. Results are given to the full digital capacity of a computer, whether or not such precision is warranted by the quality of the input parameters or by the cancellation and roundoff errors encountered. It is not difficult in the case of equation systems to program an evaluation of the results. In this paper, the sensitivity of the roots to possible errors in the given parameters is examined. 2 refs.

1130 **The epsilon algorithm and operational formulas of numerical analysis.** P. Wynn, *Maths. of Computation,* **15,** April 1961, 151-158. This paper describes, with examples, a non-linear technique, the epsilon algorithm, which appears to have powerful and general application in numerical analysis. 8 refs.

1131 **Expansion of spherical Bessel functions in a series of Chebyshev polynomials.** A. M. Arthurs and R. McCarroll, *Maths. of Computation,* **15,** April 1961, 159-162. In many problems of physics, for example the solution of the integral equations of atomic scattering, it is necessary to evaluate the spherical Bessel functions over a wide range of argument and up to a high order. This paper presents a method involving expansion in terms of Chebyshev polynomials, which in essence provides a single order for a given range of argument and which is suitable for use in automatic computations associated with atomic scattering. Results obtained on DEUCE are given. 5 refs.

1132 **Extensions of the predictor-corrector method for the solution of systems of ordinary differential equations.** C. V. D. Worrington, *Computer J.*, **4,** April 1961, 80-84. This paper is concerned with the numerical solution of systems of equations of the form

$$\frac{dy_i}{dx} = f_i = f_i\,(x, y_1, \ldots, y_n)\ (i=1,2,\ldots,n)$$

with particular reference to reducing the number of derivative evaluations required to integrate over a given range, while still retaining a check on the accuracy of the solution. Methods of generalising predictor-corrector formulae to allow different step-lengths to be used in each equation, and to allow arbitrary increments in the independent variable are developed and applications of each extension are given. Each extension is considered in some detail and the combination of the two to give an efficient general method for the solution of systems of equations is discussed. The methods are developed in terms of a particular form of fourth order predictor-corrector pair. 3 refs.

1133 **Gaussian quadrature with weight function x^n on the interval (−1, 1).** H. A. Rothmann, *Maths. of Computation,* **15,** April 1961, 163-168. The author states that most of the existent literature dealing with Gaussian quadrature formulae is based on the assumption that the relevant weight function is of constant sign in the interval of integration. This paper deals with the weight function x^n on the interval $(-1, 1)$ and indicates the extent to which the existent theory can be generalised in that case. 2 refs.

1134 **Generation of permutations by transposition.** M. B. Wells, *Maths. of Computation,* **15,** April 1961, 192-195. Many problems require the generation of all $n!$ permutations of n marks. This paper presents a generation scheme whereby each step consists of merely transposing two of the marks. 2 refs.

1135 **On modular computation.** H. B. Mann, *Maths. of Computation,* **15,** April 1961, 190-192. Description of a simple iterative procedure to determine the least non-negative residue mod M of a given residue class $(x_1, \ldots, x_s)$. 1 ref.

1136 **On the numerical computation of incomplete elliptic integrals.** G. Ehrling, *BIT,* **1,** No. 1, 1961, 8-14. This paper deals with the numerical calculation of the integrals

$$F(\varphi, k) = \int_0^{\varphi} (1-k^2 \sin^2 t)^{-\frac{1}{2}} dt$$

$$E(\varphi, k) = \int_0^{\varphi} (1-k^2 \sin^2 t)^{\frac{1}{2}} dt$$

$$\Pi(\varphi, \nu, k) = \int_0^{\varphi} (1+\nu \sin^2 t)^{-1} \cdot (1-k^2 \sin^2 t)^{-\frac{1}{2}} dt$$

when the ranges of φ and k are limited by

$$0 \leq k^2 \leq 1$$

$$0 \leq \varphi \leq \pi/2$$

Expansions are derived for the above integrals by applying birational substitutions to the integrands. 2 refs.

1137 **Numerical integration formulas of degree 3 for product regions and cones.** A. H. Stroud, *Maths. of Computation,* **15,** April 1961, 143-150. This paper discusses approximate integration formulae of degree 3; that is, formulae which are exact for polynomials of degree $\leq$ 3, of the form

$$\int_R f(x_1, \ldots, x_n)\, dx_n \ldots dx_1 \simeq \sum b_i f(v_{i_1}, \ldots v_{in})$$

for certain regions R in n-dimensional, real, Euclidean space, E_n. 6 refs.

1138 **On the numerical solution of convolution integral equations and systems of such equations.** J. G. Jones, *Maths. of Computation,* **15,** April 1961, 131-142. This paper discusses the application of a simple quadrature formula to the numerical solution of convolution integral equations of Volterra type and to systems of simultaneous equations of the same type. The convergence of the processes is considered in some detail, proofs being given that at a fixed value of the independent variable the errors in the solution tend to zero as the step length tends to zero. 5 refs.

1139 **Solution of systems of ordinary and partial differential equations by quasi-diagonal matrices.** M. A. Cayless, *Computer J.*, **4,** April 1961, 54-61. In the theory of gas discharges, the need arises for solving systems of simultaneous ordinary or partial differential equations with closed boundary conditions, some of which have eigenvalues. The coefficients of these equations are often quite complicated functions and often some of the equations are nonlinear. In this paper, methods are presented for solving systems of this type by finite differences, expressing the differential equations in terms of quasi-diagonal matrix equations, and PEGASUS subroutines are described for solving these, including cases where there are latent roots. Although primarily intended for incorporation in long special purpose programs for evaluating the characteristics of gas discharges, the subroutines are of a quite general nature and can be used to obtain solutions to a wide variety of equations expressible in this manner. 15 refs.

1140 **Some theoretical and computational matters relating to predictor-corrector methods of numerical integration.** A. Ralston, *Computer J.*, **4,** April 1961, 64-67. This paper is concerned with matters relating to predictor-corrector methods of numerical integration for the solution of ordinary differential equations. The first matter considered is the replacement of classical predictors by direct extrapolation, smoothed and unsmoothed, of the first derivative. The computational aspects of not iterating the corrector to convergence and the possible use of a convergence factor to test the corrector convergence are then discussed. Finally, the desirability of using higher order processes as opposed to modifying the results of lower order processes is considered. Some numerical results are given by way of illustration. 4 refs.

1141 **On the sum of inverses of primes and of twin primes.** C.-E. Fröberg, *BIT,* **1,** No. 1, 1961, 15-20. The sum of the inverses of the primes diverges, but it can be shown that

$$B = \lim_{N\to\infty} \left(\sum_{p=2}^{N} \frac{1}{p} - \log\log N \right)$$

exists; this paper presents a computation of this number in which the SMIL computer of Lund University, Sweden was used. 5 refs.

1142 **A table of generalized circular error.** H. Weingarten and A. R. Di Donato, *Maths. of Computation,* **15,** April 1961, 169-173. This paper provides an abbreviated table giving solutions for the value of K satisfying

$$\frac{1}{2\pi\sigma_x\sigma_y} \int_R \int \exp\left[-\frac{1}{2} \left(\frac{x^2}{\sigma_x^2} + \frac{y^2}{\sigma_y^2} \right) \right] dx\, dy = P$$

where R is the circle $x^2 + y^2 = K^2\sigma_x^2$, $\sigma_x \geqq \sigma_y$ and $c = \sigma_y/\sigma_x$. Computational and numerical analysis aspects are given of the preparation of the table on NORC. 4 refs.

TECHNIQUES

1143 **The accuracy of floating point computers.** J. V. Garwick, *BIT,* **1,** No. 2, 87-88. It is demonstrated that compared with a binary computer, the loss of accuracy with a high radix is quite significant.

1144 **ALGOL programming.** *BIT,* **1,** No. 1, 1961, 64. A section of the new journal *BIT,* in which programs and procedures written in ALGOL 60 are published, and comprising here, in addition to an indication of the requirements for publication: **Contribution No. 1—The limit of a converging sequence.** J. V. Garwick. A procedure which, given a function which tends regularly towards a value when it is entered several times, provides the limit with the accuracy obtainable on the machine.

1145 **Analog computer techniques for plotting Bode and Nyquist diagrams.** G. A. Bekey and L. W. Neustadt, *Proc. Western Joint Computer Conference,* 1960, 165-172. This paper presents two methods of plotting Bode and Nyquist diagrams with an analogue computer. Both methods have the advantage of being able to give the open loop response from closed loop simulation of a linear feedback control system. One method makes use of some trigonometric identities which yield functions which identically equal the real and imaginary parts of points in the Nyquist diagram. It makes rather extensive use of multipliers but no other nonlinear equipment is required. The other method yields phase and gain information directly, for plotting a Bode diagram. Diode and relay switching techniques are used to measure phase, and peak value readers to measure amplitude. One divider and no multipliers are required. 4 refs.

1146 **"Anatran"—first step in breeding the "Diginalog".** L. A. Ohlinger, *Proc. Western Joint Computer Conference,* 1960, 315-328. This paper describes the development at Northrop Corporation, of Anatran, a problem-oriented language, as a first step towards an analogue-digital computer or Diginalog. Anatran is an analogue symbolic language such that problems can be written in quasi-mathematical and familiar language which a digital computer will translate into a digital input function generation, a set of calculated potentiometer settings and a complete analogue flow diagram.

1147 **Computer program abstracts.** *Behavioral Science,* **6,** April 1961, 166-169. Brief descriptions (with sources of more detailed descriptions and/or complete programs) of the following programs :

a. **IBM 704 program for general analysis of variance.** A. W. Dickinson, p. 166. Analyses variances for up to 12 factors at any number of levels.

b. **Datatron 205 program for polynomial equation fitting.** W. L. Dieckmann, p. 166. Computes the coefficients of a polynomial equation of the form

$$Y = C_0 + C_1X + C_2X^2 + C_3X^3 + \ldots\ldots C_nX^n$$

given a number of data points equal to $n + 1$.

c. **IBM 704 program for the solution of simultaneous linear equations.** D. F. Kaufman and C. W. Woo, p. 166-167. The program will read in non-zero elements of the $n \times (n + 1)$ matrix of coefficients and right hand sides for a set of simultaneous linear equations. These are solved by means of a Gauss reduction with error iteration.

d. **Burroughs 205 program for selective curve set.** J. R. Walker, p. 167. Given a set of *x-y* data, this program calculates the coefficients for 36 simple, arbitrarily selected empirical equations.

e. **IBM 650 and Burroughs 205 programs for the design of optimum multifactorial experiments.** W. N. Smith and A. W. Umland, p. 167. This program is used for the statistical design of experiments and/or the analysis of data from these experiments.

f. **Least squares fit to relaxation equation.** P. J. Cislak and A. H. Emery, p. 167-168. This program calculates the values b' and c' which give a least squares fit to the equation, $y = b'(1 - ae^{-x/c'})$.

g. **Minimal IBM 650 program for numerical solution for certain systems of differential equations.** N. E. Welch, D. S. Billingsley and C. D. Holland, p. 168. Using the Runge-Kutta method, this program solves the following system of equations :

$$\frac{AdW}{dZ} + \frac{CdX}{dX} + W = G$$

$$\frac{dX}{dZ} = \left[\exp\left(B - \frac{B}{W}\right)\right](1 - X)f(X)$$

where $f(X)$ has one of the following three forms :

$$f(x) = 1$$
$$f(X) = (1 - X)$$
$$f(X) = [1 - Y(1 - X)]$$

and where

$$0 \leqq X < (1 - Y)/Y;$$
$$0 < W \leq G;\ X < 1.$$

h. **An IBM 650 program for hierarchical analysis of variance.** G. Pulley, p. 168-169. Computes the analysis of variance for a hierarchical classification design having five stages or less.

1148 **A direct digital method of power spectrum estimation.** P. D. Welch, *IBM J. Res. & Dev.,* **5,** April 1961, 141-156. This paper discusses a method of digital power spectrum estimation involving the direct combination of the sample time function with sines and cosines. This treatment is in contrast to the normal indirect digital method which proceeds through the intermediary of the autocovariance function. The procedures for setting up the frequency location and resolution characteristics of an estimation program and the program accuracy characteristics are described. The problem of the quantisation of amplitudes is discussed and related to the available spectral dynamic range. Some discussion and actual comparisons are given of the computational merit of two procedures, direct and indirect. The speed and basic characteristics are briefly discussed of an existing set of IBM 704 programs which implement the direct procedure for the study of speech signals. 4 refs.

1149 **Information retrieval in file processing I** and **II.** B. Langefors, *BIT,* **1,** Nos. 1 and 2, 1961, 54-63 and 103-112. A file is defined in this paper as a volume of information which is organised as a set of items and which is used in such a way that in each processing operation only one single item is involved. File processing, defined as a processing of such items of the file as are specified by a set of requests, consists of sorting the requests, information retrieval, and processing. In this paper, retrieval techniques are examined and in particular the effect of different degrees of random access is studied.

1150 **Mathematical applications of the Dynamic Storage Analog Computer.** J. M. Andrews, *Proc. Western Joint Computer Conference,* 1960, 119-131. This paper considers sequential calculations using DYSTAC (Dynamic Storage Analog Computer). After discussing the theory of dynamic memory, its use in performing sequential calculations is described. The evaluation of a definite integral and multiple integration are then considered. Finally, continuous memory circuitry is discussed.

1151 **A method for checking numerical codes using the 1401.** R. Kivivuori, *BIT,* **1,** No. 1, 1961, 48-53. When using the IBM 1401 to select cards coded with certain numerical combinations, the available storage capacity and computing time impose considerable restrictions, particularly if the numerical combinations do not form arithmetical entities. This paper describes a method which is fast and requires relatively little storage space. The problem may be, for example, that of editing census data, selecting occupation codes which are impossible or highly unlikely in view of a person's sex and age group. The basic idea behind the method is that, for each test and each possible numerical combination, there is one particular bit in storage that tells whether the code is acceptable or not.

1152 **A multi-level file structure for information processing.** L. Miller, J. Minker, W. G. Reed and W. E. Shindle, *Proc. Western Joint Computer Conference,* 1960, 53-60. This paper is concerned with the application of digital computers to the processing of highly formalised information specified in a natural language. A multi-level file structure for natural language and a computer algorithm which logically associates elements of the file structure are presented. It is shown how the formalised data is mapped into a vocabulary that is amenable to automatic computation. This vocabulary consists of a set of indices which retain the syntactual association of the inputs. The sets of indices constitute a file organisation which employs an associative list-type structure. 1 ref.

1153 **Optimization problems: solution by an analogue computer.** A. W. O. Firth, *Computer J.,* **4,** April 1961, 68-72. Optimisation problems in general are discussed, including the particular field of linear programming, and an analytic explanation is given of the method of solving these problems (under constraints) rapidly and accurately on an analogue computer. A simple example is given to illustrate the process of optimising a second order function. 5 refs.

1154 **A partition test for pseudo-random numbers.** J. C. Butcher, *Maths. of Computation,* **15,** April 1961, 198-199. A frequently used test on random digit sequences consists in forming from them sets of n integers; from any equalities that may exist between the integers a partition of n is defined and the actual test is on the frequency of occurrence of the different partitions of n. This paper presents a convenient way of grouping the partitions together so as to lower the number of cases and simplify the programming necessary to distinguish these cases. 1 ref.

1155 **On the reduction of error in certain analog computer calculations by the use of constraint equations.** R. M. Turner, *Proc. Western Joint Computer Conference,* 1960, 173-180. This paper describes a method of reducing the error in certain analogue computer calculations by the negative gradient technique when there is additional information about system performance in the form of constraint equations. In general, the technique leads to correction terms which are introduced into the system differential equations, but in some cases simulation is obtained by operating directly with the constraint relations themselves. The theory is developed and several examples are discussed at some length to show both the manner in which the corrections may be introduced and the character of the corrected solutions. 4 refs.

1156 **Swift's technique.** M. H. Perstein, *Commun. ACM,* **4,** Jan. 1961. A11. Letters pointing out an error in 'Evaluating numbers expressed as strings of English words', C. J. Swift, *ibid,* **3,** Oct. 1960, 541 (*C.A.,* **5,** Jan. 1961, Ref. 66).

1157 **Table look-up procedures in language processing. Part 1: The raw text.** G. W. King, *IBM J. Res. & Dev.*, **5,** April 1961, 86-92. This paper describes a method of addressing memories which is very powerful in the processing of natural languages (for information retrieval or mechanical translation), where the arithmetic or logical operations are either non-existent or do not lend themselves to algorithmic description. This method of addressing enables searching of a dictionary to be effected by table look-up without the need for a stored program. The main feature is the guarantee of initiation of an exhaustive search for a linguistic word at a point just beyond the desired address. Sequential search backwards not only locates an address if it is there but also provides identification of a longest match first. The method is further extended to provide 'conditional' addressing by prefixing subsequent addresses from information obtained in earlier searches. 6 refs.

1158 **The use of parameter influence coefficients in computer analysis of dynamic systems.** H. F. Meissinger, *Proc. Western Joint Computer Conference,* 1960, 181-192. An analogue computer technique is described which yields the partial derivatives of problem variables with respect to pertinent system parameters simultaneously with the solution of the original system differential equations. These derivatives, known as parameter influence coefficients, are valuable in enhancing the understanding of system characteristics, and often help to reduce the total number of computer runs required in a parametric system study. Sensitivity equations, derived from the original system equations by a simple differentiation process, are solved simultaneously with the original equations, to obtain the parameter influence coefficients. Typical applications of the technique are: linear extrapolation in the neighbourhood of a known solution; determination of design tolerances of a system; prediction of critical parameter values and stability boundaries. The most useful application pertains to systems disturbed by random noise where normally a very large number of computer runs would be required to analyse the system on a statistical basis in a variety of operating conditions. 5 refs.

1159 **Operating procedures for computing zero and ordinate crossings of stationary Gaussian noise using an IBM 650 calculator.** R. G. Stevens, New York University, *PB 150060,* Aug. 1959, 26 p. The operation of a group of programs for calculating estimates of the zero crossing distribution of a random stationary process is described. These programs were developed and used for the calculation of zero crossing distributions of ocean wave records. For this purpose a comparison of various methods of zero crossing estimation was undertaken. While some methods are obviously superior to others the entire group of programs is included so that similar comparisons can be undertaken if desired. The scope is limited to a description of the program operation, but a brief outline of the technique is included. 4 refs.

See also :—
General, Ref. 1087.
Mathematics, Ref. 1124, 1128 and 1139.

ACCESSORIES

1160 **The carousel memory.** *Data Processing (London),* **3,** April-June 1961, 126-130. An account of the carousel memory, a magnetic tape random access store, of Facit Electronics AB (part of AB Atvidabergs Industrier) and brief details of the Facit EDB 3 computer for which it is designed.

1161 **Communication networks for digital information.** J. M. Unk, *IRE Trans. Communications Systems,* **CS-8,** Dec. 1960, 207-214. In this paper, centralised aircraft seat reservation systems are considered as an example of the application of communication networks for digital information. Particular attention is paid to the question of reliability, speed and efficiency, and it is shown that these three factors are closely interrelated. The communication system developed by N.V. Philips' Telecommunicatie Industrie is discussed at some length.

1162 **Data transmission and the new outlook for the computer field.** M. V. Wilkes, *Computer J.*, **4,** April 1961, 1-6, disc. 6-9. Paper based on a talk given to the British Computer Society, London, 14 Nov. 1960. It is concerned with data transmission over telegraph and telephone lines, the main topics discussed being error detection and correction and the effect on future data processing developments. 8 refs.

1163 **Data transmission—problems and prospects.** P. A. Long and E. H. Truslove, *Computer J.*, **4,** April 1961, 34-37. This paper is concerned with digital data transmission in Great Britain; error rates and signalling rates are discussed and the facilities currently available for data transmission over Post Office lines are summarised. 5 refs.

1164 **Digital micrometer.** D. A. Bourne, *IBM Technical Disclosure Bull.*, **3,** April 1961, 54. Describes a micrometer which is provided with a digital readout for entering information, proportional to a measurement, into a computer register.

1165 **Drum and disc storage.** J. M. Gottschalk and W. J. Wasylenko, *Instr. & Control Systems,* **34,** April 1961, 658-661. This articles explains several techniques for magnetic recording of digital data (return-to-bias, return-to-zero, nonreturn-to-zero - change, nonreturn-to-zero - mark) and surveys the development of drum and disc stores. 5 refs.

1166 **Fixing magnetic particle images by impact.** R. L. Gamblin, *IBM Technical Disclosure Bull.*, **3,** April 1961, 14. Briefly describes the fixing of magnetic printing images by impacting with a hammer element.

1167 **High speed printing method.** J. Greyson, *IBM Technical Disclosure Bull.*, **3,** April 1961, 15. Briefly describes a printing method in which an image is imposed on a drum by a magnetic or electrostatic record head and is developed by means of powder to form a raised image. The drum is then rotated to a printing position where pressure sensitive paper is forced into contact with the raised image.

1168 **Linkage system permits combinations of analog, digital.** D. Block, *Datamation,* **7,** April 1961, 31-32. Description of a general purpose system for linking together a standard analogue computer and any one of several digital computers (namely, the IBM 700-7000 series, Bendix G-15 and Packard Bell PB 250).

1169 **Magnetic ink hopper content control.** D. E. Rutter, *IBM Technical Disclosure Bull.*, **3,** April 1961, 10-11. Describes arrangements for maintaining the level of magnetic ink particles in a hopper for a magnetic printing system.

1170 **Magnetic ink level sensing device.** M. A. Henkel, *IBM Technical Disclosure Bull.*, **3,** April 1961, 12-13. Describes an electromagnetic sensing device for controlling the supply of magnetic ink particles in a hopper for use in magnetic printing.

1171 **Magnetic tape handlers for use with electronic computers.** K. Hardisty, *Instr. Practice,* **15,** April 1961, 425-428. An account is given of the design principles of magnetic tape units for digital computers, with particular reference to a machine manufactured by Epsylon Industries Limited.

1172 **Multiple turn circular gap magnetic record head.** D. E. Rutter, *IBM Technical Disclosure Bull.*, **3,** April 1961, 9. Briefly describes a stylus type, magnetic return path recording head (e.g. for magnetic printing) which produces or senses concentric magnetic spots on a magnetisable record surface.

1173 **Phase reversal data transmission system for switched and private telephone line applications.** E. Hopner, *IBM J. Res. & Dev.*, **5,** April 1961, 93-105. An experimental phase reversal data transmission system is described, capable of operating at 2000 bauds over private telephone lines and at 1200 bauds over switched networks. The advantages and limitations of the system are discussed from a theoretical and practical standpoint. The clocking problem in data transmission is considered and several approaches are indicated. A summary is given of extensive field tests over switched and private lines in Europe and on private (SAGE) lines in the U.S.A. 6 refs.

1174 **Positioning system.** J. O. Hildebrand, *IBM Technical Disclosure Bull.*, **3,** April 1961, 57. Describes a servo system for the fine radial positioning with respect to a magnetic disc having data tracks, clock track and servo track of an arm carrying data heads, clock head and servo head.

1175 **Production of magazine labels by the Videograph process.** B. H. Klyce and J. J. Stone, *Proc. Western Joint Computer Conference,* 1960, 371-382. This paper describes a Videograph printing system developed by A.B. Dick Company for preparing subscribers' address labels for magazines published by Time Inc. It operates directly from magnetic tape master file records updated by an IBM 7070, so that computer time does not have to be used for preparing a pre-edited printing tape.

1176 **RCA's automatic store and forward message switching system.** T. L. Genetta, H. P. Guerber and A. S. Rettig, *Proc. Western Joint Computer Conference,* 1960, 365-369. A general description is given of AutoData, an automatic, fully transistorised store and forward message switching system. It is designed for use in common user communication networks in which message traffic in digital form may be relayed throughout the world.

1177 **Computer Set AN/GSQ-16 (XW-1). Volume VII: The lexical buffer.** Int. Business Machines Corp., *PB 150086-7,* 9 Feb. 1960, 246 p. High speed recording or printing of the translated output from the AN/GSQ-16 (XW-1) is achieved by means of the speed-matching capabilities of the lexical buffer core memory with its associated components and circuitry. This unit provides great adaptability for the translator with respect either to input or output and frees the translator to operate for the first time at its full speed capability. The five principal components of the system are described along with their functional characteristics, including detailed circuit and logic design. The report contains a comprehensive maintenance and operating manual for the buffer memory, output control unit and power supply, along with the present flexowriter output and the rented IBM Model 11 tape unit. See also Refs. 1178 and 1179.

1178 **Computer Set AN/GSQ-16 (XW-1). Volume VIII: Lexical buffer logic diagrams.** M. Kloomok, P. W. Case and H. H. Graff, Int. Business Machines Corp., *PB 150086-8,* 9 Feb. 1960, 285 p. Contents: Preparation and interpretation of system logic diagram; System logic diagrams—Lexical buffer memory logic, Tape control unit logic, Flexowriter control unit logic, Search logic. See also Refs. 1177 and 1179.

1179 **Computer Set AN/GSQ-16 (XW-1). Volume IX: Lexical buffer schematics.** Int. Business Machines Corp., *PB 150086-9,* 9 Feb. 1960, 172 p. See also Refs. 1177 and 1178.

1180 **Nonlinear analogue to digital converter.** L. E. Goodwin, E. I. du Pont de Nemour & Co., *DP-406,* 12 p.

1181 **Magnetic drums.** Ferranti Ltd., *B.P. 864744,* 6 April 1961. Heads are automatically maintained at a constant distance from a magnetic drum by means of a pneumatic control system which includes gas nozzles discharging against the surface of the drum.

1182 **Tape handling device.** Int. Computers & Tabulators Ltd., *B.P. 864756,* 6 April 1961. This patent describes a device which enables magnetic, paper or other tape to be unwound from the centre of a roll so as to avoid the need for a rewinding operation.

1183 **Magnetic drum.** Electric & Musical Industries Ltd., *B.P. 864987,* 12 April 1961. A non-magnetic sprayed metal layer on a drum is machined to form a smooth supporting surface for a magnetic coating.

1184 **Tape drive.** Electric & Musical Industries Ltd., *B.P. 865000,* 12 April 1961. Magnetic or other tape is driven by means arranged between two spools and means are provided for automatically stopping rotation of the spools when tension between the drive means and each spool reaches a given minimum.

1185 **Binary number display.** Electric & Musical Industries Ltd., *B.P. 866475,* 26 April 1961. Binary numbers are displayed by deflecting the beam of an electron tube to successive digit positions on a fluorescent screen and, in each such position, deflecting the beam in a linear path to represent '1' or in a closed path to represent '0'.

1186 **Head for a magnetic drum.** Associated Electrical Industries Ltd., *B.P. 866606,* 26 April 1961. A head is urged towards a magnetic drum by pneumatic means having a compressed gas supply which is also connected to a recess in the face of the head.

1187 **Buffer store for input/output.** Int. Business Machines Corp., *U.S.P. 2963685,* 6 Dec. 1960. This patent describes a buffer store employing a matrix of thyratrons.

1188 **Magnetic head of wide-write, narrow-read type.** Int. Business Machines Corp., *U.S.P. 2963690,* 6 Dec. 1960.

1189 **Analogue-to-digital converter.** Bendix Corp., *U.S.P. 2963697,* 6 Dec. 1960. An analogue-to-digital converter employing a counter operative for a period determined by the analogue signal, is provided with specified self-checking arrangements.

1190 **Digital-to-analogue converter.** Consolidated Electrodynamics Corp., *U.S.P. 2963698,* 6 Dec. 1960. A digital-to-analogue converter employing weighted resistors connecting to a common output the junctions between resistors and Zener diodes in each of several series circuits, switching being effected by transistors.

1191 **Magnetic heads.** Ex-Cell-O Corp., *U.S.P. 2965886,* 20 Dec. 1960. A locking clip for setting and locking magnetic heads.

See also :—
General, Ref. 1076*c*.

ELEMENTS

1192 **Analog time delay system.** C. D. Hofmann and H. L. Pike, *Proc. Western Joint Computer Conference,* 1960, 103-108. This paper describes the system design of the Convair-Astronautics Time Delay System which is being developed to make possible the delay of analogue functions over a greater range than is possible with more conventional means. The system is designed to handle ten channels of analogue data, delay each for the same time interval, and reproduce the functions within 0.1% for all frequencies up to 100 c/s. The delay is required to be variable from 0.01 to 10 seconds, $\pm$ 5 milliseconds. The ten analogue inputs are commutated to a single analogue-to-digital converter feeding the writing head of a special magnetic tape system. The tape travels at a uniform rate in a continuous loop and the delay is directly related to the servo-controlled length of tape between the writing and reading heads. The read data is commutated to ten digital-to-analogue converters.

1193 **An analysis of the magnetic second-subharmonic oscillator.** A. Lavi and L. A. Finzi, *Proc. IRE,* **49,** April 1961, 779-787. An analysis is given for the second-subharmonic parametric oscillator with two magnetic cores. 'Square-loop' reasoning is employed with extreme idealisation of the core properties; the effects of hysteresis losses and saturated inductance are subsequently considered. The steady state operation, both with voltage and current pump drives, is studied to determine the values of the circuit parameters for which the subharmonic oscillations occur. The transient build-up is evaluated by means of difference equations and the influence of the magnitude of the excitation signal upon the transient is illustrated. 10 refs.

1194 **Astable multivibrator.** G. Zvaigzne, *IBM Technical Disclosure Bull.,* **3,** April 1961, 36. Description of a two-transistor, collector-base coupled astable multivibrator which is stopped by applying a pulse of proper polarity to the collector of either transistor. Afterwards, astable operation is restored by applying a suitable pulse to the base of either transistor.

1195 **Binary pulse adder.** C. T. Lecher, *IBM Technical Disclosure Bull.,* **3,** April 1961, 29-30. Describes the operation of an adder employing single line transfer. The presence of a pulse on a sum line or a carry line indicates a sum '1' or carry '1' respectively. The absence of a pulse indicates a '0'. Instead of using the carry output of each stage to initiate operation of the next stage for rippling the addition process through the adder, a 'start add' signal is provided, which serves this purpose.

1196 **Characteristics of a multiple magnetic plane thin film memory device.** K. D. Broadbent, S. Shohara and G. Wolfe, *Proc. Western Joint Computer Conference,* 1960, 97-102. This paper is concerned with a memory matrix comprised of four ferromagnetic films appropriately interlaced with evaporated drive and readout conductors and insulators, all nineteen layers being vacuum deposited. The electrical characteristics of prototype elements are described and their application in computer memory systems is discussed. 1 ref.

1197 **Comments on "An analysis of cryotron ring oscillators".** T. H. Cheng, *Proc. IRE,* **49,** April 1961, 827. Letter commenting on a paper by M. L. Cohen, *ibid,* **48,** Sept. 1960, 1576-1582 (*C.A.,* **5,** March 1961, Ref. 532).

1198 **Current mode, logic-block ring circuit.** P. L. McGee, *IBM Technical Disclosure Bull.,* **3,** April 1961, 27-28. Describes the current mode, logic-block ring circuit which has only one input and can have an even or an odd number of stages. The circuit eliminates skew problems inherent in present ring circuits.

199 **DAFT-a digital/analog function table.** R. M. Beck and J. A. Mitchell, *Proc. Western Joint Computer Conference,* 1960, 109-118. In this paper, the design of a digital function generator based on incremental computer techniques and capable of generating both mathematical and arbitrary functions is described. The mathematical functions are generated using parallel digital differential analyser methods. The arbitrary functions are obtained by generating interpolating curves through programmed numerical points. The interpolating equation generates a curve made up of a chain of parabolic segments passing through 32 numerical points which may be unequally spaced along the X axis. Both second order and first order interpolation may be performed. Fourteen-bit incremental analogue-to-digital and digital-to-analogue converters are included which enables the use of the DAFT system in conjunction with analogue computers. A 3 Mc/s clock rate is used, enabling information to be transferred at 100,000 increments per second.

1200 **The dynamics of a subharmonic oscillator with linear dissipation.** G. J. Lasher, *IBM J. Res. & Dev.,* **5,** April 1961, 157-161. This paper presents a mathematical analysis of the dynamic behaviour of subharmonic oscillators (parametrons) assuming a nonlinear reactance, such as a capacitor whose potential depends quadratically on its charge but which has a linear dissipation, that is, a constant resistance. Simple equations of motion for the subharmonic and pump amplitudes are derived in the quasistatic, or high-Q, approximation. Numerical solutions are obtained for two cases. The first shows the subharmonic amplitude changing from a small value to its steady state value when a constant pump signal is applied. The second shows decay when the pump signal is removed. 5 refs.

1201 **Esaki diode memory.** H. P. Wolff, *IBM Technical Disclosure Bull.,* **3,** April 1961, 41-42. Describes an Esaki diode memory cell for a matrix, which is adapted for destructive or non-destructive readout.

1202 **Improved semiconductor diodes.** R. L. Anderson, *IBM Technical Disclosure Bull.,* **3,** April 1961, 32. Brief description of how improved diodes are made by controlling the variation of the transition capacity of the junction by control of the net charge concentration with distance from the junction.

1203 **Laminar cryotronic structures.** G. C. Stierhoff, *IBM Technical Disclosure Bull.,* **3,** April 1961, 49. Brief account of a laminar thin film cryotronic structure comprising alternate layers of normal and superconductive materials, which exhibits high values of critical temperature, critical magnetic field and critical current.

1204 **Logical circuits.** J. L. Sanborn, *IBM Technical Disclosure Bull.,* **3,** April 1961, 52-53. Describes the operation of logical circuits provided by multiple control cryotrons in which the state of the gate conductor is determined by the vector addition of applied magnetic fields.

1205 **Magnetic cores, characteristics and applications.** R. Stuart-Williams, *Auto. Control,* **14,** April 1961, 44-47. The first of a series of articles designed to provide reference material for engineers concerned with the design and application of magnetic core storage and switching units. This article deals with the characteristics and switching times of core materials generally, types of materials (thick metal tapes, thin metal tapes, thin films, ferrites) and core geometry.

1206 **Measuring the switching time of a bistable magnetic element.** W. L. Shevel, *IBM Technical Disclosure Bull.,* **3,** April 1961, 60-61. Arrangements for measuring switching times of 1 to 10 nanoseconds for bistable magnetic elements are described.

1207 **Microwave bistable circuits using varactor diodes.** C. L. Heizman, *Proc. IRE,* **49,** April 1961, 829-830. Letter describing experimental fast microwave switching circuits, with switching times of the order of a few nanoseconds, using the nonlinear capacitance and rectification properties of the varactor diode to generate a negative resistance. 4 refs.

1208 **One-tunnel-diode flip-flop.** R. A. Kaenel, *Proc. IRE,* **49,** March 1961, 622. Letter briefly analysing the operation of a flip-flop circuit employing a single tunnel diode.

1209 **Persistent current storage cell.** J. L. Sanborn, *IBM Technical Disclosure Bull.,* **3,** April 1961, 50-51. Describes a circuit employing three cryotrons operable as a persistent current storage cell; storage of '1' or '0' is detected without employing a reset method.

1210 **Regenerative semiconductor delay device.** F. C. Chiang, *IBM Technical Disclosure Bull.,* **3,** April 1961, 33. Briefly describes the operation of a device comprising a series of PNPN transistors formed by applying individual PN transistors to a common PN base. To cause the series to turn on sequentially, the device utilises the charging effect of the combined resistance and capacitance of semiconductor material.

1211 **Spool valve hydraulic digital computers.** R. N. Auger, *Auto. Control,* **14,** April 1961, 34-36. Description of a spool type valve developed by IBM as a basic logic element for hydraulic digital computers, and of a binary counter and other elements employing it.

1212 **Thin film memories increase memory system speeds.** *Auto. Control,* **14,** April 1961, 29. Brief description of magnetic thin film memory planes being produced by Burroughs Corporation.

1213 **Transistor single-shot cricuit.** H. W. Hines, *IBM Technical Disclosure Bull.,* **3,** April 1961, 35. Describes a transistor single-shot circuit providing a pulse of adjustable duration whenever the input is triggered.

1214 **Unifluxor: a permanent memory element.** A. M. Renard and W. J. Neumann, *Proc. Western Joint Computer Conference,* 1960, 91-96. This paper describes the theory and operation of the Unifluxor, a new binary permanent memory element, and the manufacture of an experimental memory employing the element. The Unifluxor does not depend on the hysteretic properties of some nonlinear material, but uses the inductive characteristics of magnetically coupled wires. Its advantages are stated to be high speed operation, easy fabrication and low cost and it is particularly suited for instruction storage in process control, missile guidance or other fixed program computers. Another possible application is dictionary storage for mechanical translation. A Unifluxor memory array consists of a printed circuit board upon which are etched longitudinal drive lines and transverse sense lines. Each intersection of a drive and sense line represents one bit, with the bits of one word lying along the same drive line. The particular state of each depends on the presence or absence of a copper slug. The slugs are contained in a plastic film cemented in place over the printed circuit board. The contents of the memory can be changed by substituting a new film with the desired pattern of copper slugs.

1215 **Using pneumatic analog computing elements for control.** C. L. Mamzic, *Control Engng.,* **8,** April 1961, 105-110. Describes pneumatic analogue devices for adding, subtracting and inverting; adding multiple inputs; multiplying and dividing; multiplying by a constant; differentiating; integrating; square root extraction; function generating; logic functions; and function limiting. An optimising and computing system employing such devices is outlined for operating a chemical reactor for maximum profit.

1216 **Varför tunneldioder?** (Why tunnel diodes?) S. Bragnum, *BIT,* **1,** No. 1, 1961, 2-7. (In Swedish) This article gives a short explanation of the basic Esaki tunneling effect and summarises the more important features of the tunnel diode. The general fabrication technique is outlined and some associated problems are discussed. 5 refs.

1217 **Variable-inversion adder.** E. D. Conroy, *IBM Technical Disclosure Bull.,* **3,** April 1961, 19-20. Current mode NP circuit block outputs, wired together for the Dot-OR (wire OR), function only when the receiving circuit demands a positive input. A PN convert block generally follows the Dot-OR to bring signals to levels suitable for a following NP + AND block. It is shown here how variable-inversion logic eliminates the need for the convert block by allowing PN −AND circuits to follow NP + AND circuits via the Dot-OR.

1218 **A word-oriented transistor driven non-destructive readout memory.** T. C. Penn and D. G. Fischer, *Proc. Western Joint Computer Conference,* 1960, 83-89. This paper dscribes a 512-word nondestructive readout memory matrix using three-aperture ferrite cores, which has been operated with transistor drivers. Writing and reading are both achieved with bipolar two-pulse sequences, which are, respectively, ERASE, WRITE and SET, READ. These pulse sequences are conveniently provided by a magnetic core switch matrix of novel design, in which all rows and columns are driven in coincidence except those intersecting at the desired address. The resultant driving current at the desired address is the sum of all the transistor driver currents, or 2 (n-1) times the individual transistor driver currents for an n square matrix. 6 refs.

1219 **Research on high-density digital storage in phosphors.** Skiatron Electronics & Television Corp., *PB 152928*, 15 July 1960. 153 p. This report is concerned with a project to determine basic limitations of packing density and operating speed, and to initiate effort towards providing an optimum dark trace tube specifically designed for high density digital storage.

1220 **Research on high temperature complex component development.** Haloid Xerox Inc., *PB 171380*, 1960, 77 p. This report is concerned with work resulting in the development of a new microminiature concept, the RC circuit plate. This plate is formed by depositing without masks, conductive, resistive and dielectric materials on a ceramic substrate. This is converted into an actual RC circuit by applying a xerographic resist pattern and selectively etching the various layers. Associated with the circuit plate is an interconnection scheme that employs printed circuit techniques. Paralleling this development of a micro circuit concept was the investigation of new materials for extreme environment operation and new methods of depositing such materials. Preliminary work on layout and formation of typical computer type circuitry is reported. 19 refs.

1221 **Tunnel diode applications to logic and pulse circuits.** I. W. Janney, Sandia Corp., *SCTM-375-60-72*, Dec. 1960, 36 p.

1222 **Counter.** A. V. Roe & Co., Ltd., *B.P. 864462*, 6 April 1961. A reversible counter for counting in a modulo greater than two, in which inputs for addition and subtraction are supplied via an OR circuit to a flip-flop whose outputs are passed to gates controlled from the inputs.

1223 **Servo-resolver for analogue computers.** Soc. Alsacienne de Constructions Mecaniques, *B.P. 864776*, 6 April 1961. A servo-resolver for converting rectangular co-ordinates to spherical co-ordinates has a rotating shaft with two positions of stable equilibrium separated by π radians and which is automatically rotated towards the nearer of these two positions.

1224 **Analogue integrator.** Marconi's Wireless Telegraph Co., Ltd., *B.P. 864963*, 12 April 1961. An integrator circuit of Miller type in which dc inputs are given an alternating component by means of a periodically varying capacitor, which component is amplified and then rectified by a phase sensitive rectifier.

1225 **Data storage system.** Kienzle Apparate G.m.b.h., *B.P. 865219*, 12 April 1961. This patent is concerned with a data storage system comprising shift registers, each element of which is connected in at least two series of elements representing different directions of data transfer. Preferably the elements are connected in a matrix which can be used as an accumulator.

1226 **Decade counter.** Tesla N.P., *B.P. 865623*, 19 April 1961. A decade counter comprising four bistable stages, is provided with ten glow discharge indicator tubes for displaying the count in decimal.

1227 **Data storage circuit.** Nat. Research Development Corp., *B.P. 865818*, 19 April 1961. A circuit employing two magnetic cores is designed for non-destructive readout.

1228 **Switching circuit.** Compagnie des Machines Bull., *B.P. 866148*, 26 April 1961. A switching circuit, particularly intended for magnetic core matrix selection purposes, comprises bistable transistor circuits and magnetic cores.

1229 **Binary multiplier.** Nat. Research Development Corp., *B.P. 866214*, 26 April 1961. In a binary multiplier, more than one partial product is fed to a serial adder, part of the output of which is fed to a single-length multiplier store.

1230 **Adder.** Nat. Research Development Corp., *B.P. 866215*, 26 April 1961. An adder, such as a seven-input serial binary adder, includes two cascades of resistors whose potentials are raised and lowered by equal increments.

1231 **Magnetic core material.** Postmaster-General, *B.P. 866431*, 26 April 1961. Magnetic strip suitable for the construction of data-storing magnetic cores, comprises a ferromagnetic metal layer bonded to a non-magnetic metal layer of high resistivity.

1232 **Transistor logic circuit.** Int. Business Machines Corp., *U.S.P. 2963594*, 6 Dec. 1960. This patent describes a logic circuit, employing transistors, resistors and diodes, which also functions as an impedance matching circuit.

1233 **Relay switching circuit for analogue signals.** Beckman Instruments Inc., *U.S.P. 2963595*, 6 Dec. 1960. A relay switching circuit for low level analogue voltages is designed to eliminate the noise fed into the contact circuitry by the relay coil drive voltages.

1234 **Transfluxor circuit for cyclic applications.** Radio Corp. of America, *U.S.P. 2963687*, 6 Dec. 1960. A system for cycling a binary digit such as is used for timing, selection, counting and like applications, employs transfluxors linked by transfer circuits each including a diode and resistor in series.

1235 **Shift register.** Radio Corp. of America, *U.S.P. 2963688*, 6 Dec. 1960. A shift register employing magnetic cores and transistors.

1236 **Transistor switching circuit.** Int. Business Machines Corp., *U.S.P. 2964652*, 13 Dec. 1960. A transistor switching circuit in which the grounded base type of operation is utilised to provide high speed.

1237 **Transistor-diode logic circuit.** Bell Telephone Labs., Inc., *U.S.P. 2964653*, 13 Dec. 1960. A logic circuit of improved reliability in which diodes are conductively coupled in the circuit between the collectors of a group of driving transistors and the input base electrode of a controlled transistor.

1238 **Shift register.** Raytheon Co., *U.S.P. 2964736*, 13 Dec. 1960. A single-core-per-bit shift register with bidirectional shifting arrangements.

1239 **Hall effect memory element.** Bell Telephone Labs., Inc., *U.S.P. 2964738*, 13 Dec. 1960. A data storage device employs a magnetic core with a gap into which a Hall effect plate is inserted.

1240 **Magnetic core assembly.** Burroughs Corp., *U.S.P. 2965864*, 20 Dec., 1960. A magnetic core has windings connected to terminals supported by insulating elements extending into and supporting the core.

1241 **Adder.** Int. Business Machines Corp., *U.S.P. 2966305*, 27 Dec. 1960. This patent describes an adder for the parallel addition of binary numbers in which the serial carry operation is broken up into groups, carries between groups being generated simultaneously with the addition of the numbers.

1242 **Analogue divider.** Gen. Precision Inc., *U.S.P. 2966307*, 27 Dec. 1960. An analogue dividing circuit capable of four quadrant operation.

1243 **Gates.** Sperry Rand Corp., *U.S.P. 2966662*, 27 Dec. 1960. A gating or buffing circuit in which the principle components are magnetic amplifiers.

1244 **Flip-flop.** Int. Business Machines Corp., *U.S.P. 2966664*, 27 Dec. 1960. A flip-flop which employs only magnetic cores.

See also :—
General, Ref. 1084 and 1087.
Applications—Simulation, Ref. 1365*c*.

ANALOGUE

1245 **The iterative differential analyzer.** M. Gilliland, *Instr. & Control Systems*, **34**, April 1961, 675-679. This article gives an account of the principles, implementation and operation of the iterative differential analyser (or repetitive analogue computer).

1246 **Versatile analogue computer for g.w. studies.** M. G. Hartley, *Control*, **4**, April and May 1961, 98-101 and 103-104. Description in some detail, with block and circuit diagrams, of an analogue computer which can simulate in a comparatively simple way a variety of missile and target courses in different guided weapon systems. 2 refs.

1247 **Special purpose analogue computer.** Industrial Nucleonics Corp., *U.S.P. 2965300*, 20 Dec. 1960. This patent describes an analogue computer for the automatic computation of the statistical variance of a characteristic subject to fluctuations in its value.

DIGITAL

1248 **ARGUS computer control system.** *Instr. Practice,* **15,** April 1961, 449-450. Brief account of the ARGUS and its proposed use by Imperial Chemical Industries Limited to act as a centralised controller replacing about 100 individual control loops for a chemical plant, and by the Central Electricity Generating Board to control start-up and shut-down of a 200 MW boiler at an electricity generating station.

1249 **Burroughs announces the B5000.** *Datamation,* **7,** March 1961, 38. Brief account of the main features of the B5000, Burroughs Corporation new solid-state digital computer system.

1250 **Communications within a polymorphic intellectronic system.** G. P. West and R. J. Koerner, *Proc. Western Joint Computer Conference,* 1960, 225-230. A multi-computer system, employing several computers of intermediate capacity, requires effective communication of data and control signals between modules of the system. This paper briefly describes the RW-400 Data Processing Central, a polymorphic data processing system. The communications problems associated with such a system are discussed, and a high speed electronic switch employing multiple-aperture magnetic cores to provide system communication is described. The utilisation of this switch in providing efficient data communication, as well as an effective control of the system modules, is explained. 2 refs.

1251 **Computer characteristics chart.** C. W. Adams, *Datamation,* **7,** March 1961, 36. Some additions and alterations to 'A chart for EDP experts', *ibid,* **6,** Nov./Dec. 1960, 13-17 (*C.A.,* **5,** Jan. 1961, Ref. 140). Tabulated characteristics are given for the following new digital computers: Burroughs 251 Visible Record Computer; IBM 1410; NCR 315 and 390; RW 400; Sylvania 9400. Manufacturer's changes in Bendix G-20; General Electric 225; IBM 1401 and 1620 are given.

1252 **The evolution of design in a series of computers, LEO I-III.** J. M. M. Pinkerton, *Computer J.,* **4,** April 1961, 42-46. This paper surveys the evolution of the functional and systematic aspects of design in the three LEO computers (I, II, III), indicating how the earlier ideas have been extended or generalised to meet actual needs. The topics dealt with include: evolution of the whole system; development of the order code; arithmetic circuits; form of information held in the systems; input/output channels; time sharing; checks and interlocks; operating controls and monitoring arrangements.

1253 **From Control Data: the 160 adds an A.** *Datamation,* **7,** April 1961, 27-28. Brief account of the main features of the Control Data 160A desk-size digital computer.

1254 **The Harvest System.** P. S. Herwitz and J. H. Pomerene, *Proc. Western Joint Computer Conference,* 1960, 23-32. The Harvest System is a large scale data processor being developed by IBM under contract with the U.S. Government, and designed for maximum performance in handling extremely large amounts of data in primarily non-arithmetic operations. It includes an IBM Stretch computer for conventional operations; in this paper only the special data processing portion is discussed. Harvest incorporates both a new system organisation and a stored program concept of macro-instructions which directly implement many useful data manipulating subroutines. Design features include a very high processing rate and an on-line table lookup facility for effecting very general transformations.

1255 **The historical development, and predicted state-of-the-art of the general-purpose digital computer.** C. P. Bourne and D. F. Ford, *Proc. Western Joint Computer Conference,* 1960, 1-21. In this paper, some of the important characteristics of general purpose digital computers which have been built or are being built are surveyed and attempt is made to extrapolate the characteristics into the 1960-1965 period. Characteristics considered include: number of addresses per instruction; number of index registers; numbers of decimal digits and bits per instruction and per data word; internal clock rate; fixed and floating point addition and multiplication times; number of memory speed levels; types of high speed memory; high speed memory size and access time; total internal memory size. Each characteristic is plotted against a calendar scale. It is concluded that the majority of computers developed up to 1965 will show very little change in performance. The names of some 300 computers are listed in an appendix. 15 refs.

1256 **The NCR 315.** *Data Processing (London),* **3,** April-June 1961, 78-81. A general account of the NCR 315 designed for processing business data, with special reference to its magnetic card random access store.

1257 **RECOMP—from II to III.** R. F. Musson, *Datamation,* **7,** March 1961, 35. Similarities and differences of RECOMP II and III are briefly reviewed.

See also :—
General, Ref. 1076*a*, 1076*b* and 1087.

PROGRAMMING

1258 **Another (nameless) compiler for the Burroughs 220.** R. S. Barton, *Commun. ACM,* **4,** Jan. 1961. A11. Letter referring approvingly to 'Comments from a FORTRAN user', J. M. Blatt, *ibid,* **3,** Sept. 1960, 501-505 (*C.A.,* **4,** Nov. 1960, Ref. 2208) and giving some details of the performance of an ALGOL-type compiler for the Burroughs 220.

1259 **Atoms and lists.** P. M. Woodward and D. P. Jenkins, *Computer J.,* **4,** April 1961, 47-53. This paper describes, in a form intended for the non-specialist, the recent work of J. McCarthy at M.I.T. on list processing by the LISP programming system. 8 refs.

1260 **Automated programming for multinomial distribution problems on the IBM 650.** J. E. Farmer, *Behavioral Science,* **6,** April 1961, 164-166. After discussing methods of programming multinomial distribution analyses such as originate from questionnaire or survey type data, a Distribution Program Generator for the IBM 650 is described. This generator writes programs to solve specific distribution problems within certain limitations.

1261 **COBOL—en introduktion.** (COBOL—an introduction). K. Volby, *BIT,* **1,** No. 2, 1961, 132-137. (In Swedish) This article is the first of a series of three introducing COBOL. The article deals with the four divisions of a COBOL program, namely Identification, Environment, Data and Procedure Divisions. Short examples are given. The other two articles will deal with COBOL grammar, and error print-out and COBOL experience with the RCA 501.

1262 **Compiling techniques for algebraic expressions.** H. D. Huskey, *Computer J.,* **4,** April 1961, 10-19. This paper presents a method of translating from algebraic formulae to computer commands in a single pass, processing the formulae from left to right. The system takes into account parenthesis, subscripted variables and real functions of a single real variable. 3 refs.

1263 **The computer operation language.** G. F. Ryckman, *Proc. Western Joint Computer Conference,* 1960, 341-344. After briefly distinguishing problem oriented and machine oriented languages, the author explores the potentialities of operator oriented language (or computer operation language). The variety of language processors have created a new function for computer operating systems, namely of interpreting a language, the computer operation language, describing the processing to be performed for a given job. In particular, the language is used to call a given processor, prescribe pertinent options and other control information.

1264 **An implementation of ALGOL 60 procedures.** J. Jensen and P. Naur, *BIT,* **1,** No. 1, 1961, 38-47. This paper is concerned with a method of implementing ALGOL 60 procedures which can handle all the basic features. After discussing the problems raised by the ALGOL 60 procedure concept—the independence of call and declaration and the name concept, the paper goes on to describe the manner in which ALGOL 60 procedures are implemented in the ALGOL translator system developed for the DASK computer of Regnecentralen, Copenhagen, Denmark. 3 refs.

1265 **Man-to-machine communication and automatic code translation.** A. W. Holt and W. J. Turanski, *Proc. Western Joint Computer Conference,* 1960, 329-339. This paper describes the ACT system developed at the University of Pennsylvania, to reduce the man-to-machine communication problem in operating the U.S. Army FIELDATA system. (The ideas are however applicable to other families of computers.) The ACT system is a programmed adjunct to a general purpose computing machine (e.g. MOBIDIC) for facilitating the initial encoding and subsequent application of specific code-to-code translation procedures, primarily for conversion of problem-oriented pseudo-codes into machine code equivalents. The ACT system provides for the 'housing' of many distinct translation procedures—carrying algebraic, data-processing, simulation languages, etc., into any of a variety of computer codes—within the bounds of a single controlling system. The ACT system includes an allocation interpreter which permits the formation of large translation programs out of large (and small) pre-stored subprograms. Without greatly impeding computation speed, the interpreter determines internal and external storage allocations for all space-taking portions of information as part of problem computation. A core library contains translation functions which play a fundamental role in a wide range of code-to-code translations. 6 refs.

1266 **More comments on COBOL.** J. E. Sammet, *Datamation,* **7,** March 1961, 33-34. The author, expressing the views of Sylvania Electric Products Inc., discusses some of the general criticisms of COBOL; she believes that COBOL will prove to be a major step forward in the computing industry.

1267 **A new approach to the programming problem.** W. Orchard-Hays, *Proc. Western Joint Computer Conference,* 1960, 345-350. In this paper, the author suggests a method of getting a problem on to a computer which involves a multi-link chain of people between problem formulator and machine operator using a hierarchy of languages for human-to-human and human-to-machine communication. The author summarises his argument as follows: 'No one can become expert in many fields simultaneously. Programming must provide *access to machines* for others, *via* the programmer but not *by* the programmer on every occasion. To expect to find individuals who can understand all the goals, restraints, techniques and policies of a large project and still be capable of translating these into a mechanised system is unrealistic. To hope that a system can be defined by one group and turned over to another for implementing is just as unrealistic. Everyone must play his proper role from the outset and communication must exist between members of a team, at the least by pairs. . . . The trick for making the hardware a useful member of a team is to construct systems which are self-adaptive in a machine oriented sense, but externally responsive in a problem oriented sense.'

1268 **The programming of large logical problems.** J. V. Garwick, *BIT,* **1,** No. 1, 1961, 21-26. This paper presents various hints on organising or planning the programming of large problems, especially of a logical nature. By a logical program is meant a program in which only a minor part is concerned with arithmetic computations. The need for extensive documentation is emphasised; at least five reports are required, namely description of problem, users manual, operators manual, simple description of program, and complete description of program.

1269 **A storage allocation scheme for ALGOL 60.** J. Jensen, P. Mondrup and P. Naur, *BIT,* **1,** No. 2, 1961, 89-102. An ALGOL 60 storage allocation scheme for the DASK computer (of Regnecentralen, Copenhagen, Denmark) which has a 2048-instruction core store and a magnetic drum store of 256 tracks of 64 instructions, is described. The use of the drum for storing program blocks and/or data must be directed by the programmer through auxiliary information in the ALGOL program. The administrative routines controlling the storage at run time are described in full and a detailed example is given. 3 refs.

N.B.—The following Refs. 1270 to 1285 provide abstracts of the papers presented at the ACM Compiler Symposium, 17-18 November 1960, Washington, D.C., which papers form most of the material in the January 1961 issue of the *Communications of the ACM.*

1270 **A basic compiler for arithmetic expressions.** H. D. Huskey and W. H. Wattenburg, *Commun. ACM,* **4,** Jan. 1961, 3-9. This paper presents a basic compiler which will compile intermediate language programs for assignment statements and arithmetic expressions involving the delimiters $+$, $-$, $\times$, $/$, (,) and $=$. The compiler, which has been tested on the IBM 704, is given as a FORTRAN program. 2 refs.

1271 **Recursive processes and ALGOL translation.** A. A. Grau, *Commun. ACM,* **4,** Jan. 1961, 10-15. This paper gives an introduction to ALGOL translator design by means of a systematic description of a basic part of an ALGOL translator. 2 refs.

1272 **Use of magnetic tape for data storage in the ORACLE-ALGOL translator.** H. Bottenbruch, *Commun. ACM,* **4,** Jan. 1961, 15-19. This paper describes how additional information is supplied to the ALGOL translator for ORACLE in order to make use of magnetic tape for auxiliary data storage. 1 ref.

1273 **The CLIP translator.** D. Englund and E. Clark, *Commun. ACM,* **4,** Jan. 1961, 19-22. CLIP, a compiler and language designed for information processing, is a research project of System Development Corporation. The compiler is divided into two parts, a generator and a translator. This paper describes the translator of a CLIP compiler written for the IBM 709.

1274 **CL-I, an environment for a compiler.** T. E. Cheatham, G. O. Collins and G. F. Leonard, *Commun. ACM,* **4,** Jan. 1961, 23-28. This paper is concerned with CL-I, a flexible, large-scale programming system for facilitating the solution of information processing problems, which has been developed and realised on the IBM 709-7090 by Technical Operations Inc. The system is based on a master file concept and has provisions for accepting, storing and retrieving both descriptions and instances of large and complex data sets, as well as algorithms defined on these data sets. Both data and algorithms may be expressed in a family of command and descriptive languages. The paper describes the 'environmental' aspects of the system which provide for intercommunication between programs and/or programmers; in particular, the concept of distinct data descriptions and the content and use of such descriptions are discussed in some detail.

1275 **The internal organization of the MAD translator.** B. W. Arden, B. A. Galler and R. M. Graham, *Commun. ACM,* **4,** Jan. 1961, 28-31. This paper describes the internal structure of an IBM 704 translator for the MAD language which is very similar to ALGOL 60.

1276 **MADCAP: a scientific compiler for a displayed formula textbook language.** M. B. Wells, *Commun. ACM,* **4,** Jan. 1961, 31-36. This paper discuses some of the features of MADCAP, a compiler for scientific problems for MANIAC II, which has been designed to largely eliminate the disparity between the 'textbook' presentation of a problem and that presentation which serves as input for a compiler.

1277 **The use of threaded lists in constructing a combined ALGOL and machine-like assembly processor.** A. Evans, A. J. Perlis and H. Van Zoeren, *Commun. ACM,* **4,** Jan. 1961, 36-41. It is pointed out that the requirements of users of an ALGOL processor may vary from rapid translation at the expense of running efficiency to the other extreme of critical dependence on the translator making full use of the machine's properties in the translated code. It is suggested by the authors that the only feasible way of providing both options is by extending ALGOL to contain a machine language assembly system. A description is given of how this has been done with the aid of threaded lists, for the Bendix G-20 at the Carnegie Institute of Technology, Pittsburgh. 3 refs.

1278 **An algorithm for coding efficient arithmetic operations.** R. W. Floyd, *Commun. ACM,* **4,** Jan. 1961, 42-51. A formula translation scheme is described which reduces the number of store and fetch operations, evaluates constant subexpressions during compilation and recognises many equivalent subexpressions. 5 refs.

1279 **A syntax directed compiler for ALGOL 60.** E. T. Irons, *Commun. ACM,* **4,** Jan. 1961, 51-55. This paper describes a compiling system which essentially separates the functions of defining the object language and of translating it into the target language. A meta-language is presented which is used to define the object language in terms of the target language and which is an extension of the syntax meta-language used in the ALGOL 60 report. A translator program is then described which utilises a direct machine representation of the meta-linguistic specifications to effect a translation. The system has been implemented at Princeton University on a Control Data 1604 to translate ALGOL 60 in its entirety to an assembly language used with the 1604.

1280 **Thunks (A way of compiling procedure statements with some comments on procedure declarations).** P. Z. Ingerman, *Commun. ACM,* **4,** Jan. 1961, 55-58. This paper presents a technique for the implementation of procedure statements, with some comments on the implementation of procedure declarations, in ALGOL 60. The basic problem involved in the compilation of procedure statements and declarations is one of transmission of information. There are three basic types of information that need to be transmitted: the value of a parameter; the place where a value is to be stored; and the location to which a transfer is to be made. In each case the requirements can be met by providing an address. A thunk is a piece of coding which provides an address. There is precisely one thunk associated with each actual parameter in each specific procedure statement. See also Refs. 1281 to 1283.

1281 **Dynamic declarations.** P. Z. Ingerman, *Commun. ACM,* **4,** Jan. 1961, 59-60. This paper describes a routine for mapping one array into another. This situation arises in the consideration of **own array**'s which are declared dynamically. In this case, the subscript bounds may change each time the declaration is invoked. See also Refs. 1280, 1282 and 1283.

1282 **Allocation of storage for arrays in ALGOL 60.** K. Sattley, *Commun. ACM,* **4,** Jan. 1961, 60-65. With ALGOL 60 there is the possibility of allowing the dimensions of an array to be defined by variables which take on their values only dynamically. This requires a mechanism for dynamically determining the location and size of an array at the time a program is run. This paper demonstrates the realisability of this feature by presenting a model of such an allocator. The basis of the approach used is that of allowing the translator to include in the coding it puts out copies of those of its own functions which cannot be carried out at compilation time. See also Refs. 1280, 1281 and 1283.

1283 **Comments on the implementation of recursive procedures and blocks in ALGOL 60.** E. T. Irons and W. Feurzeig, *Commun. ACM,* **4,** Jan. 1961, 65-69. This paper describes a mechanism for treating recursive procedures which does not cost too much in compilation and execution times and storage requirements in the compiler. See also Refs. 1280 to 1282.

1284 **Compiling techniques for Boolean expressions and conditional statements in ALGOL 60.** H. D. Huskey and W. H. Wattenburg, *Commun. ACM,* **4,** Jan. 1961, 70-75. In this paper compiling routines are described for Boolean expressions involving the operators $\vee$, $\wedge$, and $\neg$. The Boolean variables allowed include relational expressions. These routines are then used in describing procedures for compiling conditional statements and Boolean assignment statements as defined in ALGOL 60.

1285 **The SLANG system.** R. A. Sibley, *Commun. ACM,* **4,** Jan. 1961, 75-84. This paper reports works on a project for developing a programming language suited to the task of writing compiler type programs. A language which has been developed is referred to as SLANG. The notation is patterned after ALGOL and has proved to be convenient for expressing many of those processes fundamental to automatic programming. The project has focused attention on the area of programming research concerned with the observation: it is possible to describe processes in a machine-independent language which are in themselves machine dependent. Results indicate that it is not only possible to describe the compilation process for a problem-oriented language in a machine-independent manner, but that such a description can be translated into the machine language of any of a class of computers by a single program running on a single computer. 4 refs.

See also :—
General, Ref. 1082.

APPLICATIONS

AERONAUTICAL

1286 **Experience with a digital comuter in an aeroplane testing establishment.** B. R. Taylor, *Computer J.,* **4,** April 1961, 25-29. This paper is concerned with data processing experience at the Ministry of Aviation's Aeroplane and Armament Experimental Establishment which caters for the operational testing of aircraft and aircraft armament systems. After briefly describing the HEC 2M computer installation and the types of data processing performed, operational difficulties with regard to such matters as simplicity, flexibility and reliability, and some techniques adopted to overcome them are discussed in general terms.

1287 **Re-entry guidance and flight path control.** J. E. Vaeth, *IRE Trans. Space Electronics & Telemetry,* **SET-6,** Sept.-Dec. 1960, 99-103. The capabilities and limitation of a specific flight path control law for range manoeuvring during the atmospheric phase of re-entry from orbit, as determined by a digital computer study, are presented. 2 refs.

1288 **The effects of time varying aerodynamic coefficients on aeroelastic response.** R. H. MacNeal, J. H. Hill and B. Mazelsky, Computer Engineering Associates Inc., *PB 171407,* April 1960, 109 p. An investigation was made of the effects of time-varying aerodynamic coefficients on the flexure-torsion flutter problem during rapidly accelerated vertical flight. These effects are likely to be significant in the transonic flight regime of a rocket-boosted vehicle. A mathematical analysis of systems of linear differential equations with slowly varying coefficients is presented. Simplified approximate solutions are derived from this analysis. An analogue computer investigation of a lifting surface with pitch and plunge degrees of freedom and time-varying aerodynamic coefficients is described in which the free transient response and the response to continuous excitation were measured for a variety of parameter configurations. These results compare satisfactorily with response envelopes predicted by a simplified analytical method. 13 refs.

1289 **An extended Euler angle coordinate system for use with all-attitude aircraft simulators.** D. T. Greenwood, Michigan University, *PB 171404,* Aug. 1960, 30 p. This report considers the problem of finding a suitable coordinate system for representing orientation. The new extended Euler angle system is compared with other coordinate systems (ordinary Euler angle system, reversed Euler angle system, and quaternion system), particularly with respect to the output variables and the amount of analogue computer equipment required for simulator representation. The extended Euler angle system requires the most equipment but has the advantage of being an all-attitude system with outputs convenient for cockpit display. 5 refs.

1290 **Lunar trajectory studies and an application to Lunik III trajectory prediction.** A. Petty and I. Jurkevich, General Electric Co., *PB 153492,* July 1960, 109 p. This report covers three closely connected areas. These are: (1) Design of a fast, accurate and efficient computer program for computation of lunar trajectories. (2) An application of the resulting program to an error analysis of specific lunar trajectories and to the determination of some actual trajectories. As an example the trajectory of Lunik III is considered in detail. (3) Tracking program (determination of initial conditions to be used in the equations of motion). 12 refs.

1291 **Some results of estimating satellite elements from Millstone-Hill averaged data.** H. D. Fridman, M.I.T., *PB 153220,* 2 Nov. 1960, 32 p. The Millstone Hill site of the Lincoln Laboratory is a tracking facility from which raw radar data and data averaged over intervals of time were obtained. In order to make use of the raw radar data averaged over a number of time intervals a programming facility that calculates the satellite orbit parameter from the known position and velocity of the satellite at a given time of observation was constructed. The system by which the radar data on the satellites was acquired, the techniques by which the data has been filtered and smoothed, and the programming system that made use of this data to evaluate the technique of estimation are described. 3 refs.

1292 **Space vehicle ephemeris and differential correction program unified theory.** Aeronutronic, *PB 153744,* 14 June 1960, 48 p. This report traces the development of a differential correction theory for lunar and space probes. To overcome the singularities inherent in differential processes with conventional two-body descriptions of the path, as the eccentricity passes through unity in either the parabolic or rectilinear sense, a unified formation of the two-body equations was developed. The differential correction procedure is based upon an ephemeris, integrated in Encke form by special perturbations, and upon differential expressions derived from the unified two-body equations. The report includes experimentation with simulated range, range-rate, azimuth, right ascension and/or declination data to evaluate the performance of the resulting IBM 709 program.

1293 **West Ford orbit determination.** A. A. Mathiasen, M.I.T., *PB 153219,* 2 Nov. 1960, 19 p. The IBM 7090 West Ford Orbit Determination program accepts geocentric coordinate data, from which it determines the orbit parameters (semi-major axis, eccentricity, argument of perigee, inclination, longitude of ascending node, epoch of nodal crossing) existing and presumed constant, during the time interval of the data. These parameters are then made available to other programs.

1294 **West Ford statistical orbit prediction program.** W. R. Crowther, M.I.T., *PB 153218,* 2 Nov. 1960, 6 p. A program was written to perform statistical prediction of orbit parameters. It accepts many sets of orbit parameters and determines a least mean squares fit of each parameter to a polynomial with time as its variable. The polynomial may be chosen to be a constant, linear, or quadratic by a control card.

See also :—
Simulation, Ref. 1365*b*.

BUSINESS

1295 **ADB för folkbokföring och skatteuppbörd i Sverige.** (ADP for population registration and tax accounting in Sweden.) O. Dopping, *BIT,* **1,** No. 2, 1961, 65-68 (In Swedish). English summary: 'A governmental Swedish committee has suggested conversion to ADP for the file maintenance involved in population registration, tax accounting, etc., with a tape-oriented IBM 7070 and five IBM 1401 satellite computers. Investment in hardware, building, etc., $>$ 6 M$; planning, programming, and file conversion 4 M$. Estimated annual savings, taking depreciation of initial costs into account: 2 M$/yr. Reduction of clerical force more than 1,000.'

1296 **Computers centralize inventory control at Square-D.** B. Cross, *Control Engng.,* **8,** April 1961, 152-157. Description of how two IBM 305 RAMAC computers are used to maintain sales records and the inventory levels of finished products and component parts in each of twelve warehouses and the factory of the Industrial Controller Division of Square D Company. Two IBM 1401 computers are to replace the IBM 305 RAMACs.

1297 **A decade of work.** K. Bean, *Auto. Data Processing,* **3,** April 1961, 26-29. This article outlines the plans of Commercial Union Assurance Company for insurance data processing with a KDP 10.

1298 **How they prepare to build a car.** R. Wilcox, *Auto. Data Processing,* **3,** April 1961, 21-22, 44. Description of the use by Standard-Triumph International Limited of Friden Programatic Flexowriter machines for preparing documents required for car production and also tapes for production stock control by LEO IIC.

1299 **Merchandise accounting.** *Data Processing (London),* **3,** April-June 1961, 100-113. Description of use of an EMIDEC 1100 by Boots Pure Drug Company Limited for performing all the routine clerical tasks associated with supplying a range of 1,800 different photographic products to 1,300 branches.

1300 **Michigan National Bank.** E. H. Goodman, *Data Processing (Detroit),* **3,** April 1961, 15-17. Outlines the data processing system employing a Burroughs 220 computer and other Burroughs machines, used by the Michigan National Bank.

1301 **The use of Pegasus Autocode in some experimental business applications of computers.** H. W. Gearing, *Computer J.,* **4,** April 1961, 30-34. This paper describes the use by the Metal Box Company Limited of the Pegasus Autocode in preparing programs for three business applications of a statistical nature. The applications are concerned with analysis of a market survey, experimental sales forecasting and quality control. 11 refs.

CHEMICAL

See :—
Miscellaneous, Ref. 1371.

CONTROL—GENERAL SYSTEMS

See :—
Techniques, Ref. 1145.

CONTROL—PRODUCTION AND PROCESS

1302 **Collecting process data for an on-line digital computer.** D. A. Fluegel, E. D. Tolin and J. R. Parsons, *Control Engng.,* **8,** April 1961, 147-150. This article describes a data collection system developed by Phillips Petroleum Company for use with a RECOMP II in on-line control of thermal cracking furnace in an ethylene plant. 5 refs.

1303 **Process control by computer.** M. James and W. T. Lee, *Automn. Progress,* **6,** April 1961, 122-126. An account of the design features of the de Havilland ANATROL analogue computer, which employs a time-sharing principle, and some of the ways in which it may be used for on-line process control. 1 ref.

See also :—
Elements, Ref. 1215.
Digital, Ref. 1248.

ELECTRONICS

1304 **Tunnel diode large-signal simulation study.** S. B. Geller and P. A. Mantek, *Proc. IRE,* **49,** April 1961, 803-804. Letter comparing the results of investigations of tunnel diode equivalent circuit for large-signal dynamic response using analogue computer simulation and graphical analysis techniques. 3 refs.

1305 **The pulsed analog system for evaluating correlation functions for radar.** C. G. Bell, M.I.T., *PB 153560,* 9 Aug. 1960, 25 p. Because of the finite width of the aerial pattern, scanning radars generate a number of pulse echoes from the same target, and data processing is required to determine the correct target azimuth for each group of echoes. This processing is complicated by pulse-to-pulse noise. Cross-correlation with the aerial gain pattern or other filters appears advantageous for improved azimuth location of the target but has not been widely used because of the computational speed required. This report describes an experimental study of a pulsed-analogue correlator simulated by operating the TX-O computer with associated time-shared analogue computing elements under digital program control. With each analogue operation, such as multiplication, complete in 10 μsec (within the 12 μsec TX-O instruction time) a 65-point cross-correlation between 100 data points and a 35-point filter function was completed in 4.83 milliseconds—about twice the time represented by the data points. Suggestions are given for construction of a pulsed-analogue correlator which would operate on radar data in real time. 7 refs .

See also :—
Simulation, Ref. 1365*d*.

ENGINEERING, ELECTRICAL

1306 **The simulation of saturable reactors with digital differential analyzers.** G. Savastano, *Ann. Assn. Int. Calcul Analogique,* **3,** April 1961, 64-73. A system of two differential equations and eight algebraic equations representing the operation of a saturable reactor made up of two magnetic cores, is presented. The simultaneous solution of these equations to determine output and control currents, magnetic fluxes and magnetomotive forces, on digital differential analysers is described. Results obtained on the Bendix D-12 digital differential analyser at the University of Naples are discussed. 11 refs.

See also :—
Digital, Ref. 1248.

ENGINEERING, MECHANICAL

1307 **Real-time automobile ride simulation.** R. H. Kohr, *Proc. Western Joint Computer Conference,* 1960, 285-300. A complete study of automobile ride must include the road (input) waves, car suspension dynamics and passenger response to the resulting ride motions. This paper describes a Ride Simulator capable of carrying two passengers and subjecting them to realistic ride motions, and which offers a new approach to suspension design. The simulator consists of a magnetic tape unit providing road wave inputs, an analogue computer which determines from these inputs the resulting car body motions, and a motion simulator which reproduces the car body motions determined by the computer. 8 refs.

1308 **Road load computer brings highway to lab.** D. Winston, *Control Engng.,* **8,** April 1961, 161. Brief account of an analogue computer developed by Donner Scientific Company, which operates through a controller and power amplifier to regulate the torque applied by dynamometer rollers to the rear wheels of a road vehicle being tested.

See also :—
Miscellaneous, Ref. 1371.

INFORMATION RETRIEVAL

1309 **Correspondence.** C. J. Maloney; R. A. Fairthorne, *Computer J.,* **4,** April 1961, 85. Two letters referring to 'Prime number coding for information retrieval', A. H. Cockayne and E. Hyde, *ibid,* **3,** April 1960, 21-22 (*C.A.,* **4,** June 1960, Ref. 1052) and mentioning prior publications on that subject. 7 refs.

1310 **The Fact Compiler: a system for the extraction, storage, nd retrieval of information.** C. Kellogg, *Proc. Western Joint Computer Conference,* 1960, 73-82. (N.B. Compiler is not used ere in the programming sense.) This paper outlines the organiation of the Fact Compiler, a system for the timely extraction f significant information from source data and for the storage f this information in an organised manner that permits rapid etrieval. The Fact Compiler also facilitates the processing or nanipulation of the stored data in ways not readily possible vith decentralised storage systems. The system is readily adapt-ble for use with present reporting techniques used in industry; nput data is immediately recorded in the memory and is avail-ble for immediate use. Information is stored according to a ogico-linguistic structure and use is made of a language called Restricted English which consists of a vocabulary of specially elected English words. The system is composed of human and machine elements: the human elements exercise judgment and perform decision-making functions while the machine elements perform the routine processing. The system uses a general purpose digital computer and a high capacity, rapid access, magnetic memory.

1311 **Matching inquiries to an index.** M. A. Wright, *Computer J.,* **4,** April 1961, 38-41. This paper presents a method for measuring the degree of matching between inquiries and index entries (names, for example) which allows for the effect of mistakes and of omissions of characteristics. The method makes use of information gain as used in communication theory. A description is given of a DEUCE program designed to demonstrate the use of classification, heuristic and information gain techniques as applied to finding records in an index. 5 refs.

1312 **Symbolic logic in language engineering.** H. M. Semarne, *Proc. Western Joint Computer Conference,* 1960, 61-71. This paper discusses the use of symbolic logic in the construction of decision devices useful in the classification, correlation and selection of documents and, more briefly, in mechanical translation. The basis of the symbolic logic approach is non-arithmetical. It features a very flexible matching ability and is general with respect to machinery. 16 refs.

1313 **Infomation retrieval study.** J. O'Connor, University of Pennsylvania, *PB 153770,* 31 March 1960, 10 p. Contents: The possibilities of document grouping for reducing retrieval storage size and search time; On retrieval in aid of scientific discovery; A note on the possibility of a divided structure file permitting arbitrary substructure searches; Some suggested mechanised indexing investigations which require no machines.

1314 **A survey of computer programs for chemical information searching.** E. C. Marden and H. R. Koller, National Bureau of Standards, *PB 161586,* Feb. 1961, 87 p. After a brief description of different chemical notation systems, indexing and abstracting procedures, punched card systems and special purpose literature searching machines, twelve computer systems for searching chemical literature are described. Linguistic and other difficulties attendant on literature searching are discussed. 197 refs.

See also :—
Techniques, Refs. 1152 and 1157.
Medical, Refs. 1318, 1331, 1341, 1344 and 1345.

MECHANICAL TRANSLATION

1315 **The outlook for machine translation.** F. L. Alt, *Proc. Western Joint Computer Conference,* 1960, 203-208. This paper first surveys the main difficulties in the way of mechanical translation and the methods that have been proposed to overcome them. More detailed consideration is given to the approach of the National Bureau of Standards in order to illustrate the problems associated with mechanical translation. Projects at twelve American, two British and one Italian centre are then briefly outlined. Finally, economic considerations are dealt with at some length, including program development cost, equipment costs and machine time requirements. 3 refs.

See also :—
General, Ref. 1076*d*.
Techniques, Ref. 1157.
Information retrieval, Ref. 1312.

MEDICAL

1316 **Analyzing medical data—some statistical considerations.** J. E. Walsh, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 362-366. Noting that the heterogeneous and complicated nature of medical data places severe restrictions on its analysis, the feasibility of establishing standard procedures for the analysis is discussed. It is pointed out that computational difficulties can be overcome by the use of a high speed, large memory digital computer. Principles of mathematical statistics and their application to investigation of medical data are outlined.

1317 **A computer solution for determination of thermal tissue damage integrals from experimental data,** A. M. Stoll, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 355-358. This paper would appear to be the same as the report *PB 146959* (*C.A.,* **4,** Dec. 1960, Ref. 2499). 5 refs.

1318 **Data processing considerations in the handling of medical data.** E. C. Smith, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 359-362. This paper examines the growing interest in data processing of medical data, exploring problems of machine design, problem formulation and analysis. Four basic problem areas (clinical patient data, basic research, diagnosis and medical document retrieval) and their interaction with equipment design are discussed.

1319 **Preparing psychophysiologic analog information for the digital computer.** H. Zimmer, *Behavioral Science,* **6,** April 1961, 161-164. This paper describes a system for the analogue-to-digital conversion of psychophysiologic information for statistical analysis by digital computer. After describing means for obtaining signals representing skin resistance, respiration, muscle action potential voltage, heart rate, finger pulse amplitude, skin temperature and body-weight shifts, the operation of equipment for producing from these signals a tape carrying data in binary code and IBM format is outlined.

1320 **Recapitulation of conference.** M. Eden, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 232-238. Introduction by the Guest Editor to the Proceedings of Conference on Diagnostic Data Processing, Rockefeller Institute, New York, 14 January 1959, which Proceedings constitute pages 232 to 317 of the October 1960 issue of the *IRE Transactions on Medical Electronics* (the papers are abstracted in Refs. 1321 to 1345 which follow). In this introduction the papers are discussed in groups under the headings: mechanical devices for differential diagnosis; devices for sharpening diagnosis by objective tests; basically non-numerical aids to diagnosis; and the collection and utilisation of medical data.

1321 **Welcome — introduction to the conference.** V. K. Zworykin, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 239. Very brief introduction to the Conference on Diagnostic Data Processing, New York, 14 January 1959, indicating the mounting interest in the subject.

1322 **The mechanical conservation of experience, especially in medicine.** F. A. Nash, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 240-242, disc. 242-243. This paper discusses the advantages to a doctor of mechanical aids for diagnosis, with special reference to the author's Grouped Symbol Associator or Logoscope, a slide-rule type of device with which the possible diseases causing a combination of observed symptoms can be speedily ascertained. 3 refs.

1323 **Correlation of data with a digital computer in the differential diagnosis of hematological diseases.** M. Lipkin, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 243-245, disc. 246. This paper briefly describes how, by automatic correlation on a digital computer, information describing 49 hospital cases in the field of hematology was compared with information characterising 20 diseases.

1324 **An analog approach to computer diagnosis.** L. J. Brannick, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 247-248. This paper briefly describes an approach to diagnostic computation in which a disease is defined in terms of its symptoms and their relative significance in the characterisation of that particular disease. These 'definitions' are then converted into analogous resistive networks for use as standards in a special analogue computer which compares a group of symptoms representing an unknown disease with each of the standards.

1325 **Computers and clinical psychiatry.** P. G. S. Beckett, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 248-249, disc. 249-250. Psychiatrists collect a vast amount of clinical information in lengthy interviews with patients. It is suggested in this paper that the information can be reliably recorded on a series of scales in a form suitable for processing by digital computer. A method of recording currently in use in a Michigan hospital is presented and its advantages and disadvantages discussed. 5 refs.

1326 **Diagnostic aspects of computer applications in medical research at the University of Pennsylvania.** M. L. Rockoff, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 250-252. In this paper the diagnostic implications of medical research using a digital computer are discussed according to the type of mathematical analysis and/or computer technique employed. Illustrative examples of the use of a UNIVAC at the University of Pennsylvania include the solution of differential equations in anesthesiology, the use of Fourier analysis in ballistocardiology, and the use of multiple regression analysis in neoplastic chemotherapy. 5 refs.

1327 **Major problems in the use of computing machines.** R. Taylor, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 253-254. Matters such as the following are briefly discussed: how will medical histories recorded by machine be used by medical people and institutions; exactly how can the doctor take advantage of the computer as an aid to diagnosis; the necessity for laboratory data to be in a form suitable for computer input; handling of graphical and pictorial information such as 'EKG, EEG and X-ray pictures'; communication between doctor and computer.

1328 **Computer programming of diagnostic tests.** L. B. Lusted, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 255-258. After reviewing various ways in which the digital computer can assist in medical diagnosis, the logical determination (or programming) of diagnostic tests needed in a specific case is considered with the aid of examples. 6 refs.

1329 **Use of a digital computer in the analysis of intestinal motility records.** J. T. Farrar, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 259-263, disc. 263. Methods do not exist for the rapid, quantitative analysis of complex phasic patterns such as are seen on records of intraluminal gastrointestinal pressure or other parameters of motility. This paper describes how, in an attempt to develop a more satisfactory method, these waveforms were converted into digital form and then analysed by WHIRLWIND I at M.I.T. Generation of the autocorrelation function and the power density spectrum of these records permits a numerical, quantitative expression of certain information contained in the curves. 6 refs.

1330 **Computers and psychophysiology in medical diagnosis.** A. F. Ax, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 263-264. This paper outlines an approach to psychiatric diagnosis using psychophysiology and the digital computer. Apparatus has been designed to sample, digitise and magnetically record for computer input up to 29 physiological variables as recorded on the intact human. Specialised procedures have been developed for computing independently on continuous variables the four aspects of correlation—lag, coincidence, amplitude and slope. 6 refs.

1331 **Storage and retrieval of the results of clinical research.** M. Eden, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 265-267, disc. 267-268. Digital computer procedures are outlined for analysing the grammatical structure of a sentence without respect to the meaning of words and for transforming a complicated sentence into simple sentences. The possibilities of such procedures for machine indexing and abstracting and for the flexible retrieval of data pertinent to specific clinical problems is discussed.

1332 **The use of computers in physiologic diagnosis.** D. L. Fry, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 269. This paper, which in its printed form appears to have been very greatly shortened, is concerned with the establishment of mathematical models that approximately describe the various parts of the cardiovascular and pulmonary systems, from which descriptive equations can be derived for solution by digital computer. The solutions are of potential diagnostic value.

1333 **Diagnosis of arterial disease with analog computers.** R. W. Stacy, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 269-271, disc. 271-273. This paper is concerned with the analogue simulation of arterial and other physiological systems in order to obtain data, hitherto unavailable, on the condition of such systems for diagnostic use. It is possible, by using an analogue computer to simulate the behaviour of the arterial system, to compute a peripheral pulse wave which closely approximates the peripheral pulse wave recorded from a patient, when the central pulse wave recorded from that patient is used as a forcing function. A second-order differential equation is used, describing primarily the vibratory behaviour of the system. When behaviour duplication is verified, the equation parameters may be analysed to provide data on arterial elasticity and blood viscosity and mass.

1334 **Digital electronic methods for infrared spectroanalysis.** R. H. Taplin, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 273-274, disc. 274. Brief description of the use of a special purpose fixed program digital computer for the quantitative analysis of very complex spectrometric mixtures, for example the infrared spectrum of a mixture of several steroids. 1 ref.

1335 **Using electronic computers in medical diagnosis.** R. S. Ledley, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 274-277, disc. 277-280. The author puts forward the proposition that in order to be able to use a computer as an aid in medical diagnosis, the mathematical foundation of the medical diagnostic processes must first be well understood. Three mathematical disciplines are inherently involved in the diagnostic processes: logic and probability in diagnosis and value theory in the choice of treatment.

1336 **IBM Type 704 medical diagnosis program.** T. Tanimoto, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 280-282, disc. 282-283. This paper describes how an IBM 704 program operates to determine the most significant characteristics (symptoms or results of a laboratory test) of a medical case. 1 ref.

1337 **Digital computers and medical logic.** R. Ebald and R. Lane, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 283-286, disc. 286-288. This discusses very briefly the logical structure of a program designed to analyse and determine significant relationships between sets of symptoms drawn from actual case histories and a 'classical' set in a group of hematological diseases. A printed output is reproduced.

1338 **Diagnosis, therapeutics, prognosis, and computers.** F. Paycha, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 288-290. After briefly discussing the logical structure of medicine and distinguishing the activities of diagnosis, therapeutics and prognosis, the problem of using available knowledge is considered. It is suggested that this problem of storage and utilisation of medical knowledge can be solved by a logical ternary system applied to computers, the three values of the ternary system being used to indicate that a symptom is present, absent or has not been sought. 3 refs.

1339 **Doctor-machine symbiosis.** J. J. Baruch, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 290-292, disc. 293. The author uses 'symbiosis' as an accurate description of the kind of interdependence of doctor and machine necessary for effective machine-aided diagnosis. It is first postulated that in a good working relationship between a doctor and an existing computer, the computer plays the role of a graduate student with a fantastic memory and the doctor that of a mortal with a failing memory and much experience in observation. The problem is then considered of making a computer function in the way it is thought a diagnostician functions. The interaction of doctor and computer in the evaluation of observations is discussed. Finally, the questions of economics and procedure is examined.

1340 **Diagnostic video data processing.** L. B. Lusted, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 293-294, disc. 294. This paper briefly describes preliminary studies of the application of a spatially-oriented computer to the 'reading' of chest X-ray photofluorograms and separation of obviously abnormal chest films from normal chest films. 1 ref.

1341 **Electronic data processing of national vital statistics.** H. L. Dunn, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 295. This paper discusses very briefly the application of data processing systems at the U.S. National Office of Vital Statistics. There are also some remarks on the uniqueness of the individual as part of the machine-aided diagnosis problem.

1342 **Digitation of clinical and research data in serial evaluation of disease processes.** W. A. Spencer and C. Vallbona, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 296-308. The authors state that the fullest possible description of disease and its consequences should be attempted for illness often has manifestations affecting many aspects of living. Methods that can increase the variety, frequency and depth of observations should assist the physician. The flow of information between the patient and physician is examined in order to develop extensive application of electronic data processing for clinical use and research in chronic disease. Efforts are described to use electronic data processing to document the natural history of quadriplegic poliomyelitis patients. Experiments described include: streamlining the recording and listing of the routine statistical elements of the medical record; posting in alphanumerical form and recording digitally for later analysis simple nursing and medical records; condensed summary listing of laboratory data and functional test data; and assembly, re-ordering, computation and biostatistical handling of physiological data accumulated in respiratory, cardiovascular and neuromuscular studies of healthy and ill subjects. Technical problems that have been identified are discussed.

1343 **Some reflections on medical diagnosis by electronic data processing machines.** G. R. Meneely, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 309-312, disc. 313. The feasibility of medical diagnosis by digital computer is considered and it is concluded that it is feasible and worthwhile, although involving a great deal of effort and expense.

1344 **Possible applications of EDP in daily practice.** W. A. Kelly, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 314. This paper briefly indicates the possibilities offered by a centralised file of information about patients readily available to any doctor.

1345 **Some comments on the usefulness of electronic data processing in medical practice.** T. P. Almy, *IRE Trans. Medical Electronics,* **ME-7,** Oct. 1960, 315-316. In this paper, history-taking by a doctor is considered as dealing with past history and with present illness. Past history can be handled by data processing in the form of a centralised file, but it is suggested that the doctor-patient relationship is essential to the taking of the history of the present illness.

MILITARY

1346 **Computers for field artillery.** L. R. van de Velde, *Proc. Western Joint Computer Conference,* 1960, 209-224. This paper points out that the Artillery stands at that point in the field army at which technical, mathematical computing meets automatic data processing—the instrument of logistics, battlefield management and command. After describing the Artillery's requirements for mathematical computing, the type of computers required and a possible scheme of location are briefly considered. Data processing requirements are then discussed and, finally, a portion of the complete system within the Field Artillery is outlined as it might look a few years hence.

1347 **Study of antiaircraft systems by simulation with a Monte Carlo model.** B. Jansson, *BIT,* **1,** No. 1, 1961, 27-37. After briefly describing the terminology in the subject of simulation used at the Research Institute of National Defence in Stockholm, Sweden, the main features are presented of a large scale Monte Carlo model of an air battle involving various types of aircraft, anti-aircraft guns and anti-aircraft missiles, which model has been programmed in FORTRAN for the IBM 7090. 2 refs.

See also :—
Analogue, Ref. 1246.
Simulation, Ref. 1365*a* and 1365*e*.

NUCLEAR

1348 **Analog computer serves as both systems analysis tool and operator training facility for Enrico Fermi Atomic Power Plant.** S. N. Irwin and R. R. Kley, *Proc. Western Joint Computer Conference,* 1960, 301-313. This paper describes an analogue simulator with specially designed electromechanical equipment, developed to simulate one of three loops of the Enrico Fermi Power Plant, including all elements except the steam turbine, i.e. the reactor, intermediate heat exchanger, steam generator, mixing and transport delay phenomena, and steam system hydraulics. A philosophy of plant control was evolved on the basis of plant operating characteristics, as determined by the simulator and supported by a steady-state digital analysis of the plant. Conceptual control hardware designs were then tested on the simulator and an optimum design was selected and tuned. Actual hardware of the automatic control system was simulated, and this simulation circuitry incorporated in the computer. Control consoles exactly duplicating the control panel layout in the actual plant were connected to the analogue simulator to adapt it for power plant operator training. 3 refs.

1349 **Designing an automatic rod control system.** J. J. Loving, *Auto. Control,* **14,** April 1961, 51-56. An account of the designing by Westinghouse Electric Corporation of an automatic control system for the control rods of the BR-3 nuclear reactor which is being installed at the Mol site in Northern Belgium. Brief details are given of full scale simulation by analogue computer of the reactor plant and control sysem. 2 refs.

1350 **Adjoint flux computation and other additions and improvements to the equipoise program; the three-dimensional prototype program, whirlaway.** M. L. Tobias and T. B. Fowler, Oak Ridge National Lab., *CF-60-8-10,* Aug. 1960, 6 p.

1351 **Analog computer study of the MSR-ORR in pile pressurized water loop no. 1.** S. J. Ball, Oak Ridge National Lab., *CF-60-5-50,* May 1960, 12 p.

1352 **Analog computer study of the 255 Mw ASGR core kinetics.** H. H. Cappel, Atomics International, *NAA-SR-Memo-5146,* March 1960, 38 p.

1353 **CAT—an IBM 704 program for coolant actuated transients in an open-lattice core.** L. S. Tong, Westinghouse Electric Corp., *YAEC-145,* Feb. 1960, 80 p.

1354 **2G-2R spherical reactor code for the IBM-704.** T. B. Fowler, Oak Ridge National Lab., *CF-60-1-100,* Jan. 1960, 19 p.

1355 **KATE-1. A program for calculating Wigner-Wilkins and Maxwellian averaged thermal constants on the Philco-2000.** H. J. Amster and J. B. Callaghan, Westinghouse Electric Corp., *WAPD-TM-232,* Oct. 1960, 57 p.

1356 **Kinematics of nuclear reactions calculated with the IBM-704 computer.** B. D. Williams, Oak Ridge National Lab., *ORNL-2963,* 8 p.

1357 **Lattice calculations using the IBM-704 Wanda-2-diffusion code.** W. O. Allen et al, Atomics International, *NAA-SR-Memo-2033,* Aug. 1957, 8 p.

1358 **709 program for reduction of exponential pile data.** D. D. Matsumoto, General Electric Co., *HW-60388,* May 1959, 14 p.

1359 **SLOP-1—A thermal multigroup program for the IBM-704.** H. Bohl et al, Westinghouse Electric Corp., *WAPD-TM-188,* Oct. 1960, 151 p.

1360 **Variable moderator reactor development program. Quarterly progress report no. 3.** Advanced Technology Laboratories Division of American-Standard, *ATL-A-107,* Feb. 1960, 147 p. Includes attachments:
I. Kinetics model for boiling water reactors. F. E. Romie.
II. Boch—A program for computing the hydrodynamic performance of boiling water reactors. J. O. Bradfute et al.
III. Puree—A method and code for the calculation of physics properties of H_2O moderated power reactors. J. W. Webster et al.

PHYSICS

1361 **The numerical solution of a parabolic system of differential equations arising in shallow water theory.** J. Heller and E. Isaacson, AEC Computing & Appld. Maths. Center, New York University, *AEC Res. & Dev. Report NYO-9372,* 15 Oct. 1960, 20 p. In this report, a finite difference approximation to a non-linear set of parabolic differential equations arising in shallow water theory is given. These difference equations were used to determine on an IBM 704, the shape and rate of propagation of a hump of fluid down a channel of constant depth. The hump of fluid was found to spread instead of steepen as is the case in the usual shallow water theory. 5 refs.

1362 **On stability criteria of explicit difference schemes for certain heat conduction problems with uncommon boundary conditions.** A. N. Lowan, *Maths. of Computation,* **15,** April 1961, 179-185. Stability criteria are derived for the explicit difference schemes appropriate to the following problems: heat conduction in a slab in contact with a well stirred liquid; heat conduction in a slab radiating to one face of a thin slab with infinite thermal conductivity, the other face of which radiates into a medium at prescribed temperature; heat conduction in a cylinder radiating to the inner surface of a thin coaxial cylindrical shell with infinite thermal conductivity, the outer surface of which radiates into a medium at prescribed temperature. 4 refs.

1363 **A table of three integrals related to the Planck function.** A. D. Anderson, M. P. Shuler and R. R. Best, Naval Research Lab., Washington, D.C., *PB 149296,* 6 Oct. 1960, 19 p. A table of three integrals related to the Planck radiation function prepared using NAREC. These integrals give the absorption rate, energy flux and number of photons absorbed in a volume element at a given distance from a point source. 1 ref.

See also :—
Mathematics, Ref. 1131 and 1139.

SIMULATION

1364 **Comparison of two ways of simulating a simple tubular heat exchanger.** T. Hennig, *Ann. Assn. Int. Calcul Analogique,* **3,** April 1961, 56-59. This paper is concerned with a study of a simple tubular heat exchanger on an analogue computer. It was desired to investigate the transient behaviour of the water temperature as a function of distance x along the tube and of time t, due to a step change in steam temperature. The partial differential equations describing the heat exchanger incorporate the two independent variables x and t. Analogue computer methods employing difference equations in the two variables are described and compared and it is shown that in several cases higher accuracy can be obtained with difference equations in t than with equations in x.

1365 **Simulation Council Newsletter.** J. H. McLeod (Ed.), *Instr. & Control Systems,* **34,** April 1961, 681-684, 687, 689. This issue consists mainly of summaries of the following papers (*a* and *b* given at the Western Simulation Council meeting of 10 Nov. 1960; *c* to *e* at the Southeastern Simulation Council meeting of 11 Nov. 1960) :—

a. **Pre- and post-flight simulation.** L. K. Yoskowitz, p. 681-682. Discusses analogue and digital techniques for missile flight simulation before and after test flights.

b. **Automatic computer application to Northrop T-38 inertia-roll coupling analysis.** R. L. Wolpert, p. 682. A digital and an analogue computer are used to investigate inertia-roll coupling phenomena of the Northrop T-38 Supersonic Trainer.

c. **Development of a practical high-speed digital simulator.** F. Shaver, p. 683. Describes the general philosophy used in incorporating the digital differential analyser modules of Packard Bell Computer Corporation into a practical computer or simulator.

d. **Analytical description and simulation of an automatic telemetry tracking antenna system.** R. C. Nichols and J. B. Bailey, p. 683-684. Describes use of an analogue computer in design of an automatic telemetry tracking aerial system.

e. **Analog and digital methods for analyzing and compensating missile control systems.** V. R. Brenes, R. W. Lanzkron and W. Lee, p. 684, 687.

TRANSPORT

See :—
Accessories, Ref. 1161.
Engineering, mechanical, Refs. 1307 and 1308.

MISCELLANEOUS

1366 **The analysis of surveys: processing and printing the basic tables.** F. Yates and H. R. Simpson, *Computer J.,* **4,** April 1961, 20-24. In their previous paper, 'A general program for the analysis of surveys', *ibid,* **3,** Oct. 1960, 136-140 (*C.A.,* **4,** Dec. 1960, Ref. 2497), the authors dealt mainly with that part of an Elliott 401 program which compiled basic tables from survey information. The present paper describes the second part of the program which processes the basic tables and prints out the results.

1367 **Bearbejdning af valgresultater pa DASK.** (Processing of election results on DASK.) A. Melbye, *BIT,* **1,** No. 2, 1961, 113-129. (In Danish) English summary: 'This paper describes the first attempt made in Denmark to use a computer for processing election results. This took place November 15, 1960, when the voting results from the election of the Danish Folketing were read into the computer DASK which in turn produced a number of different tables for presentation on radio and television, showing expected (forecasted) results as well as accounts of actual results compared with the previous election. The article contains a description of how the job was organised within and outside the computer and a survey of the events during the election night when the computer was running from 9 p.m. until 1.30 a.m. Special attention is given to the methods used by the computer for forecasting and to a discussion of the relative merits of different methods as judged from different measures of precision.' 3 refs.

1368 **The computer-based classroom.** H. Bergstein, *Datamation,* **7,** April 1961, 18-20. Account of research by System Development Corporation in computer-based automated teaching using a Bendix G-15D at present and a Philco Transac S-2000 in the future. See also Refs. 1369 and 1370.

1369 **Programming a computer to teach.** D. Englund and D. Estavan, *Datamation,* **7,** April 1961, 20-22. Account of the programming of the G-15D and Philco Transac S-2000 for automated teaching. See also Refs. 1368 and 1370.

1370 **Equipment for automated teaching.** M. Bendick, *Datamation,* **7,** April 1961, 23-24. Description of equipment developed by System Development Corporation for use with the Bendix G-15D in research into automated teaching. See also Refs. 1368 and 1369.

1371 **Computer uses.** *Instr. & Control Systems,* **34,** April 1961, 662-663. Applications in the chemical, mechanical and other fields of the Bendix G-15 by 24 American firms are listed.

1372 **A computer program for processing signals received in radar astronomy experiments.** P. L. Fleck and T. J. Goblick, M.I.T., *PB 152827,* 14 Oct. 1960, 21 p. In 1958 and 1959, the Lincoln Laboratory attempted to obtain radar reflections from the planet Venus. The received data was analysed on an IBM 709. This report describes the General Detection Program (written mainly in FORTRAN) that was used for the data processing. 6 refs.

1373 **Proceedings of the Conference on Automatic Data Handling for Oceanographic Observations, Woods Hole, Massachusetts, October 8, and 9, 1959.** Woods Hole Oceanographic Institution, *PB 153134,* Feb. 1960, 16 p. At the conference, the WHOI (Woods Hole Oceanographic Institution) data handling system was described in some detail. The advantages of this and similar type systems were discussed according to some of the particular requirements of the conferees. The areas of discussion are: a generalised description of data acquisition, storage, reduction and analysis; description of WHOI system; inter-range instrumentation group standards; extended applications of WHOI or similar systems; data acquisition over long time periods; and standardisation. 3 refs.

1374 **Programming study of a digital computer for processing the UNICOM message heading.** H. E. Ulfers, Army Signal Res. & Dev. Lab., Fort Monmouth, New Jersey, *PB 153002,* 1 June 1960, 34 p. The feasibility of employing a commercial, general purpose digital computer for processing the message heading in UNICOM is studied. The DATATRON 220 is used to execute a test program. The average processing time of a standard message heading is 10 ms. To serve more than a hundred subscribers within one second, it is necessary to use a faster computer. A fast, special purpose digital computer would have advantages over the DATATRON 220 due to its limited but more specific instructions. Furthermore, it should be able to handle binary or octal digital words. 1 ref.

1375 **The theoretical computation of equilibrium compositions, thermodynamic properties and performance characteristics of propellant systems.** H. N. Browne and M. M. Williams, Naval Ordnance Test Station, China Lake, California, *PB 153181,* 8 June 1960, 59 p. A computer program has been developed for the calculation of the high temperature thermodynamic properties and performance characteristics of propellant systems. This report is a summary of the methods and equations used in the program which will handle a maximum of 12 chemical elements and 70 combustion products. Flame temperature, chemical composition, enthalpy, entropy, specific heat ratio and molecular weight of both the chamber and exhaust, frozen and shifting equilibrium specific impulse, boost velocities, relative boost velocities, thrust coefficient, characteristic velocity and exhaust gas velocity are computed. The assumptions made, the limitations imposed and the input data required for the solution of a specific problem by use of the program are discussed in detail. Appendices provide a working guide for those using the program. 7 refs.

1376 **The U.S. Weather Bureau-Sandia Corporation project on wind climatology: Results, computer programs, and magnetic tape records—II (an IBM 704 program for calculating altitude-time correlations of wind).** M. K. Weston, Sandia Corp., *SCTM-211-60-51,* Nov. 1960, 58 p.

See also :—
General, Refs. 1083 and 1087.
Techniques, Ref. 1159.

BOOKS

1377 **Proceedings of the Western Joint Computer Conference, 1960.** ix+382 pages, $3.00. Contains the papers presented at the Joint IRE-AIEE-ACM Computer Conference, San Francisco, California, U.S.A., 3 to 5 May 1960. The papers, which are abstracted in this issue as listed below, are arranged under the following headings :—

Computer organization trends: Refs. 1095, 1097, 1254 and 1255.
Data retrieval: Refs. 1152, 1310 and 1312.
Components and techniques: Refs. 1196, 1214 and 1218.
Analog equipment: Refs. 1150, 1192 and 1199.
Learning and problem-solving machines: Refs. 1109, 1117 and 1118.
Analog techniques: Refs. 1145, 1155 and 1158.
Trends in computer applications: Refs. 1079, 1315 and 1346.
Logical design: Refs. 1091, 1092 and 1250.
Design, programming, and sociological implications of microelectronics: Refs. 1081, 1082, 1083 and 1084.
Analog applications: Refs. 1146, 1307 and 1348.
Programming systems: Refs. 1263, 1265 and 1267.
Input-output and communications: Refs. 1112, 1175 and 1176.

AUTHOR INDEX

Adams, C. W. 1251
Allen, F. K. 1094
Allen, W. O. 1357
Almy, T. P. 1345
Alt, F. L. 1315
Amster, H. J. 1355
Anderson, A. D. 1363
Anderson, G. P. 1076
Anderson, R. L. 1202
Andrews, J. M. 1150
Arden, B. W. 1275
Arthurs, A. M. 1131
Auerbach, I. L. 1080
Auger, R. N. 1211
Ax, A. F. 1330

Babcock, M. L. 1119
Bailey, J. B. 1365*d*
Ball, S. J. 1351
Barton, R. S. 1258
Baruch, J. J. 1339
Bauer, W. F. 1095
Bean, K. 1297
Beck, R. M. 1199
Beckett, P. G. S. 1325
Bekey, G. A. 1145
Bell, C. G. 1305
Bendick, M. 1370
Bergstein, H. 1368
Best, R. R. 1363
Billingsley, D. S. 1147*g*
Block, D. 1168
Bohl, H. 1359
Bottenbruch, H. 1272
Boudreau, P. E. 1089
Bourne, C. P. 1255
Bourne, D. A. 1164
Bradfute, J. O. 1360
Bragnum, S. 1216
Brannick, L. J. 1324
Brenes, V. R. 1365*e*
Brenza, J. G. 1091
Broadbent, K. D. 1196
Brooks, R. W. 1098
Browne, H. N. 1375
Butcher, J. C. 1154

Callaghan, J. B. 1355
Cappel, H. H. 1352
Carré, B. A. 1128
Case, P. W. 1178
Cayless, M. A. 1139
Cheatham, T. E. 1274
Cheng, T. H. 1197
Chiang, F. C. 1210
Churchman, C. W. 1083
Cislak, P. J. 1147*f*
Clark, E. 1273
Collinge, R. 1126
Collins, G. O. 1274
Comley, W. 1124
Conroy, E. D. 1217
Cross, B. 1296
Crowther, W. R. 1294

Dellacato, F. C. 1099
Dickinson, A. W. 1147*a*
Dieckmann, W. L. 1147*b*
Dolotta, T. A. 1092
Donato, A. R. Di 1142
Dopping, O. 1295
Doyle, W. 1117
Dunn, H. L. 1341

Earle, J. 1100
Ebald, R. 1337
Eden, M. 1320 1331
Ehrling, G. 1136
Emery, A. H. 1147*f*
Englund, D. 1273 1369
Estavan, D. 1369
Estrin, G. 1097
Evans, A. 1277

Fairthorne, R. A. 1309
Farmer, J. E. 1260
Farrar, J. T. 1329
Feurzeig, W. 1283
Finzi, L. A. 1193
Firth, A. W. O. 1153
Fischer, D. G. 1218
Fleck, P. L. 1372
Floyd, R. W. 1278
Fluegel, D. A. 1302
Ford, D. F. 1255
Ford, N. C. 1093
Forrington, C. V. D. ... 1132
Fowler, T. B. 1350 1354
Friberg, J. 1127
Fridman, H. D. 1291
Fröberg, C.-E. 1141
Fry, D. L. 1332

Galler, B. A. 1275
Gamblin, R. L. 1166
Garwick, J. V. ... 1143 1144
..... 1268
Gearing, H. W. 1301
Gelernter, H. 1109
Geller, S. B. 1304
Genetta, T. L. 1176
George, F. H. 1108
Gilliland, M. 1245
Goblick, T. J. 1372
Goodman, E. H. 1300
Goodwin, L. E. 1180
Gottschalk, J. M. 1165
Graff, H. H. 1178
Graham, R. M. 1275
Grau, A. A. 1271
Greene, P. H. 1118
Greenwood, D. T. 1289
Greyson, J. 1167
Guerber, H. P. 1176
Guerin, E. J. 1076

Hansen, J. R. 1109
Hardisty, K. 1171
Harmon, L. D. 1112
Hartley, M. G. 1246

Heckler, C. H. 1101
Heizman, C. L. 1207
Heller, J. 1361
Henkel, M. A. 1170
Hennig, T. 1364
Herwitz, P. S. 1254
Hildebrand, J. O. 1174
Hill, J. H. 1288
Hines, H. W. 1213
Hofmann, C. D. 1192
Holland, C. D. 1147*g*
Holland, J. H. 1081
Holt, A. W. 1265
Hopner, E. 1173
Huskey, H. D. ... 1262 1270
..... 1284

Ingerman, P. Z. ... 1280 1281
Irons, E. T. 1279 1283
Irwin, S. N. 1348
Isaacson, E. 1361

Jackson, R. C. 1091
James, M. 1303
Janney, I. W. 1221
Jansson, B. 1347
Jenkins, D. P. 1259
Jensen, J. 1264 1269
Jones, J. G. 1138
Jurkevich, I. 1290

Kac, M. 1089
Kaenel, R. A. 1208
Kaufman, D. F. 1147*c*
Kellogg, C. 1310
Kelly, W. A. 1344
King, G. W. 1157
Kiseda, J. R. 1096
Kivivuori, R. 1151
Kley, R. R. 1348
Kloomok, M. 1178
Klyce, B. H. 1175
Koerner, R. J. 1250
Kohr, R. H. 1307
Koller, H. R. 1314
Kovach, L. D. 1124

Lane, R. 1337
Langefors, B. 1149
Lanzkron, R. W. 1365*e*
Lasher, G. J. 1200
Lavi, A. 1193
Lecher, C. T. 1195
Ledley, R. S. 1335
Lee, W. 1365*e*
Lee, W. T. 1303
Lees, M. 1123
Leonard, G. F. 1274
Lipkin, M. 1323
Long, P. A. 1163
Loveland, D. W. 1109
Loving, J. J. 1349
Lowan, A. N. 1362
Lusted, L. B. 1328 1340

McCarroll, R. 1131
McCluskey, E. J. 1092
McGee, P. L. 1198
McLeod, J. H. 1365
MacNeal, R. H. 1288
Maley, C. E. 1129
Maloney, C. J. 1309
Mamzic, C. L. 1215
Mann, H. B. 1135
Mantek, P. A. 1304
Marden, E. C. 1314
Mathiasen, A. A. 1293
Matsumoto, D. D. 1358
Meissinger, H. F. 1158
Melbye, A. 1367
Meneely, G. R. 1343
Miller, L. 1152
Minker, J. 1152
Mitchell, J. M. 1199
Mondrup, P. 1269
Musson, R. F. 1257

Nash, F. A. 1322
Naur, P. 1264 1269
Neumann, W. J. 1214
Neustadt, L. W. 1145
Newell, A. 1082 1107
Nichols, R. C. 1365*d*

O'Connor, J. 1313
Ohlinger, L. A. 1146
O'Keeffe, W. H. 1086
Orchard-Hays, W. 1267

Parsons, J. R. 1302
Paycha, F. 1338
Penn, T. C. 1218
Perlis, A. J. 1085 1277
Perstein, M. H. 1156
Petersen, H. E. 1096
Petty, A. 1290
Pile, H. L. 1192
Pinkerton, J. M. M. ... 1252
Pomerene, J. H. 1254
Pulley, G. 1147*h*

Raben, M. W. 1088
Ralston, A. 1140
Reed, W. G. 1152
Renard, A. M. 1214
Rettig, A. S. 1176
Rhodes, W. H. 1091
Riesel, H. 1125
Riet, E. K. Van De 1101
Rockoff, M. L. 1326
Romie, F. E. 1360
Rothmann, H. A. 1133
Rutter, D. E. 1169 1172
Ryckman, G. F. 1263

Salzer, J. M. 1079
Sammet, J. E. 1266
Sanborn, J. L. 1204 1209
Sattley, K. 1282